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MAGAZINE

of Heinrich Heine University Düsseldorf

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Igniting solar fire on Earth

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PHOTO EUROFUSION

Energy from nuclear fusion can be a key component in the energy supply of the future. Researchers from HHU are involved in realising this.

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Democracy is dependent on participation: 100,000 people demonstrated against right-wing extremism and the far-right AfD political party by the Rhine in Düsseldorf in January 2024.

Legal notice

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Outlook

PHOTO LUKAS SCHULZE

Dear Reader,
It is summer here on campus, and both students and staff are enjoying the long days as well as the numerous places to sit outside in the sun or shade. The cover story of this *HHU Magazine* is about the solar fire, which makes our stars shine and life on Earth possible, and which researchers are also seeking to create artificially in fusion power plants. You can read in this issue about a heat that is infinitely stronger than the sunlight we feel, and sometimes suffer from, during summer time.

For many of us, summer may also mean a greater likelihood of sleepless nights. While we learn in this issue that a deficit of just a few nights can easily be caught up, neuroscientists report from a meta-study that there are more long-lasting effects on the brain in cases of chronic sleep disorders. The good news is that understanding precisely which brain regions are affected improves the chances for a targeted therapy. And there is more research based on brain diagnosis reported in this issue: Using electroencephalography, psycholinguists have explored memory effects after storytelling, which can be influenced by such minor changes as the accent on a word. Language is processed very quickly, and whether what we say will be relevant, or forgettable, for an audience can depend on very slight nuances in our speech. By contrast, if you are interested in non-verbal forms of expression, you may want to read our report on LEGO® SERIOUS PLAY®, a new method that SeLL, the Service Center for Good Teaching and Learning at HHU, is now offering in its training.

I wish you an enjoyable read and a great summer!

With best regards,

Professor Dr Heidrun Dorgeloh
Vice President for University Culture and International Relations

COVER CHRISTOPH KAWAN

Sleepless nights leave their mark – not only on our appearance

Neuronal effects of sleeplessness

PHOTO PEXELS – RON LACH

BY VICTORIA MEINSCHÄFER

Almost everyone is familiar with the unpleasant feeling of not having had enough sleep the night before. You feel tired and cold, and struggle to concentrate all day. The body can cope with a few sleepless nights well, but chronic sleeplessness is something else entirely: It has a clear impact on the brain. And researchers from the Institute of Systems Neuroscience (Institute Director: Professor Dr Simon Eickhoff) have now proven that this impact differs from the effects of a sleepless night in a meta-study.

round 20 – 35% of the population suffer from chronic sleep disorders and this figure rises to 50% in older people. This statistic is disturbing as "poor sleep is one of the most important – yet influenceable – risk factors for psychological conditions in adolescents and older adults," says the Jülich-based neuroscientist PD Dr Masoud Tahmasian. This is because adolescents and older people are per se more susceptible to disruptive influences. Adolescents because, during puberty, the brain undergoes substantial maturation and thus restructuring processes, which disrupt sleep. And older people because their ability to compensate is reduced by the normal ageing process. "Accordingly, there is no period of life during which poor sleep has fewer or no negative consequences," says Professor Eickhoff. He also points out in this regard that – as is essentially the case with all aspects of neurobiology – there is a clear inter-individual variance: "Some people need less sleep, while others need more. Some can cope with phases of sleep deprivation better than others."

Is it possible to compensate for lost sleep?

Long-term, abnormal sleep disorders – such as insomnia, obstructive sleep apnoea or narcolepsy – and short-term sleep loss affect different regions in the brain, as has now been proven. In this context, "short-term" means a period of two to max. three weeks. "However, the aspect of compensation is perhaps more important," says Eickhoff. "In the case of acute problems, individuals usually manage to catch up on their sleep quickly (at least in part), i.e. if someone gets very little sleep for several nights in a row, they might doze off on

the sofa early in the evening and then end up sleeping for 12 hours. Chronic sleep disorders are characterised by the fact that there is never any real compensation, i.e. the body (and the brain) are constantly in a sleep deficit."

Lack of attention, irritability, exhaustion

Chronic and short-term sleep loss initially feel similar, but differences can be identified on closer examination. "The symptoms of both forms of sleep deprivation manifest themselves in a similar way during the day," says Gerion Reimann, who completed his master's thesis on this topic at the Institute of Neurosciences and Medicine (INM-7) at *Forschungszentrum Jülich* (Jülich Research Center – FZJ). "Everyone who has had a night of poor – or insufficient – sleep knows that you often feel a little grumpy or cannot do your work well as your concentration and reactions are significantly impaired." However, no clear delineation to the symptoms of chronic sleep deprivation can be identified. "Lack of attention, exhaustion or irritability can for example be seen in cases of both acute and chronic sleep loss," explains Eickhoff. "And an interesting aspect can be noted with regard to mood. In the case of acute sleep deprivation, it tends to be slightly elevated, while it is essentially always negative in the case of chronic sleep loss." However, chronic sleep loss has severe consequences for the brain. Studies show that frequent sleep deprivation impairs brain development, disrupts the removal of harmful cellular metabolites from the brain, reduces emotional stability and significantly impacts working memory, as well as school and work performance. "Chronically poor sleep and sleep disorders are also risk factors for various psychological conditions," emphasises Reimann. Changes in the anterior cingulate cortex, the right amygdala and the hippocampus – one of the key control centres in the brain – were identified in individuals with chronic sleep disorders. These regions are involved e.g. in the processing of emotions, memories, decisions and sensory impressions. By contrast, short-term sleep loss was associated with changes in the right thalamus – a region responsible for thermoregulation, movement and pain perception. "This also correlates with the symptoms of short-term sleep deprivation," says Reimann: "You are less concentrated, more restricted in your actions and often feel the cold more."

Examining various sleep disorders in a differentiated way

According to the study, which analysed 231 brain studies and examined and compared multiple groups, it is clear that there are significant neuronal differences between the groups. "We were able to show that certain regions in the brains of people with pathological/chronic and temporary sleeplessness vary, although this does not mean that there are no overlaps at all," says Gerion Reimann. "It is quite possible that some regions in the brain are similar in both cases, but that these similarities are less distinctive. The various sleep disorders should also be considered in a differentiated way: In the case of chronic sleep disorders, emotional factors often play a greater role – such as the fear of poor sleep – and that is reflected in certain regions in the brain. In other

"In the case of chronic sleep disorders, emotional factors often play a greater role – such as the fear of poor sleep – and that is reflected in certain regions in the brain."

Gerion Reimann — neuroscientist

> “We currently presume that the neurobiological aspects are a consequence of reduced sleep in the case of acute sleep deprivation. On the other hand, there are also conditions such as idiopathic insomnia, which manifest themselves in the form of chronic sleep disorders.”
>
> **Professor Simon Eickhoff — neuroscientist**

forms such as sleep apnoea, regions are more likely to be affected, which control fundamental bodily functions – for example thermoregulation, which overlaps functionally with the region found in the thalamus. So, our results point to differences, but do not rule out certain common features. This is important for future studies. It is now possible to focus on the structural and functional regions and networks, which are representative for the respective sleep disorders.”

More targeted therapies and preventive measures

The new findings can also pave the way for more targeted therapies and preventive measures. “Many patients who suffer from insomnia or chronic sleep disorders in general also have a higher risk of depression, anxiety or other psychological disorders, as well as Alzheimer’s and other dementia conditions,” says Reimann. “As we now know which regions in the brain are involved, we can conduct a more detailed examination of the effects of drug-free therapies such as cognitive behavioural therapy or continuous positive air pressure therapy (CPAP) compared with pharmacological treatments for various sleep disorders.”

What is not yet known is whether the changes in the brain are the cause or a consequence of the chronic sleep disorder: “We currently presume that the neurobiological aspects are a consequence of reduced sleep in the case of acute sleep deprivation,” says Eickhoff. “On the other hand, there are also conditions such as idiopathic insomnia, which manifest themselves in the form of chronic sleep disorders. It therefore seems plausible that sleep loss has a neurobiological cause, at least in certain individuals. And precisely how the different aspects of sleep behaviour and neurobiology are linked is the focus of our research.”

MORE INFORMATION

→ **Gerion M. Reimann, Alireza Hoseini, Mihrican Koçak, Melissa Beste, Vincent Küppers, Ivana Rosenzweig, David Elmenhorst, Gabriel Natan Pires, Angela R. Laird, Peter T. Fox, Kai Spiegelhalder, Kathrin Reetz, Simon B. Eickhoff, Veronika I. Müller, Masoud Tahmasian. Distinct Convergent Brain Alterations in Sleep Disorders and Sleep Deprivation – A Meta-Analysis. JAMA Psychiatry (2025) https://doi.org/10.1001/jamapsychiatry.2025.0488**

Seeing what will be forgotten

An electroencephalogram (EEG) makes things to be remembered and things to be forgotten visible

BY VICTORIA MEINSCHÄFER

“Tamara had pearls, rubies and sapphires in her safe. She needed money, so she sold the rubies. Who is Tamara? Why does she have such precious stones in her safe?” That is not actually important here, because Professor Dr Katharina Spalek (Institute of Linguistics), who is telling this story, is much more interested in what the people who hear the story actually remember about it afterwards. And she can now already determine what listeners will be able to remember later on by means of an electroencephalogram (EEG) conducted while they are listening.

PHOTOS ISTOCKPHOTO – TOSCAWHI/RETOUCHMAN/KLAMATATRATIP

The neuro- and psycholinguistics expert conducts research on the effect of contrastive focus accent on memory and, with her study "Contrastive focus accent retroactively modulates memory for focus alternatives: evidence from event-related potentials", has demonstrated that what will be forgotten and what will be remembered is already encoded in the brain during listening. In the case of Tamara, that means: When a word – here: rubies – is spoken with a slight focus accent and a specific pattern appears in the brain of study participants in the EEG, the participants will also be able to remember the alternatives to the word rubies, i.e. pearls and sapphires, better. If this pattern cannot be seen for a word, the participant will not remember all three things. "Such studies have only been realised using vocabulary lists to date," says Spalek. "The participants were observed via EEG while learning words by heart and were later asked to remember the words." The Düsseldorf-based psycholinguist is however interested in whether this effect is also evident in the case of short stories.

What changes when a word is emphasised?

The study was set up as follows: 50 study participants heard a total of 80 stories in eight blocks while an EEG was conducted. In half of the stories, one word was emphasised slightly via a contrastive focus accent, while there was no accent in the other half of the stories. After each set of ten stories, participants were asked questions to establish what they had remembered and what they had forgotten (what did Tamara originally have in her safe?). "We then split the results into two groups: one in which the participants remembered two or more words and the other in which they had forgotten the words. The results of the two groups were then overlaid." This created two curves: one containing all EEG data in which words were remembered and a second collating the data in which words were forgotten. And the results were surprising: The participants not only remembered the word with the focus accent better (in our case: rubies), but also the accompanying words. "A strong focus accent apparently indicates to the brain that there are relevant alternatives," says Spalek. And indicating that an accompanying word is relevant makes it easier to remember, even when such words are not emphasised. "This is referred to as a subsequent memory effect (SME)," says Spalek. "This means that the neuronal activity during memory encoding varies. If the focus accent on one word (rubies) is stronger, the participants are better able to remember it and the accompanying words later on."

> "Language processing is generally something that happens very quickly."
>
> **Professor Katharina Spalek — neurolinguist**

A clear pattern is visible following the stimulus

If the word is encoded in the memory, a clear pattern can be seen in the brain around 300 milliseconds after the stimulus – the curve enters the positive range. 300 milliseconds is roughly how long it takes to blink quickly four times – that is all the time needed to hear a word, understand it and store it in the brain with a small marker. While the participants continue to be bombarded with further information. "Language processing is generally something that happens very quickly," says Spalek. "Hear, process, understand, store, respond – this all happens within an extremely short time, again and again throughout the day." And for all those who would like their dialogue partners to remember what they tell them, this means: If you set focus accents on certain words, it is more likely that the story will not be forgotten.

ORIGINAL PUBLICATION

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PHOTO ACHILLE ABBOUD/DPA

Sophie Schönberger examines the crisis in democracy

When division and polarisation are on the rise

BY CAROLIN GRAPE

Democracy is dependent on participation – on the active involvement of citizens. However, this fundamental requirement of democracy seems to be increasingly under threat. Democracy in Germany is under pressure from declining electoral turnout, increasing political apathy and the rise of radical, authoritarian forces.

The renowned legal expert Professor Dr Sophie Schönberger participates in interviews, lectures and essays on the current debates surrounding the crisis in liberal democracies in the West. In her work, the Professor of Public Law and Co-Director of the Düsseldorf Party Research Institute (PRUF) focuses on the challenges facing democratic societies today. And above all, on the question of why democratic principles are increasingly being perceived as a burden.

"The crisis in democracy is a creeping process – bolstered by social and technological trends over the past 20 years: the loss of social milieus and ties, and the transformation, which has occurred in the media," says Sophie Schönberger. While modern democracies were once based on the idea of a collective "we", societies today are strongly oriented toward the individual and their self-actualisation. Schönberger's theory: Wherever you look, the focus lies on being special, outstanding, individual and somehow different. The goal is to be the best possible version of yourself and set yourself apart from others. Striving for individual identity also encourages the exclusion and degradation of other groups, and makes democratic discourse more difficult.

The willingness to observe democratic conventions has declined sharply in recent years, as can be seen here at a demonstration against the coronavirus measures.

Tolerating differences, accepting majority decisions and living with contradictions are all part of democracy. However, these requirements are increasingly being perceived as unreasonable. "Democracy is not a personal self-actualisation project, nor is it an ego trip. It is not just about me, but rather about the democratic community and the fact that the majority ultimately decides in the democratic process. The fundamental principle of democracy is that I have to accept the majority, even if I do not belong to it." And willingness to do so has fallen sharply in recent years. That is a problem and it is being exacerbated by the digitalisation of communications. "Loss of inhibitions, isolation and one-sided debates all lead to division and polarisation," says Schönberger, "populist movements are increasing." The collective we of democrats has long since become a case of us versus them or even me against everyone else in some parts of the population.

Digitalisation as a driver

"Where people doubt everything, believe everything is wrong and no longer see the point of a State, then everything that makes our society work, starts to disintegrate," says Schönberger.

The mechanisms of filter bubbles and algorithms are contributing to people increasingly only interacting with like-minded individuals and simply ignoring opinions, which differ from their own. Political discourse has shifted into the digital realm, where it is often conducted in a less inhibited, more radical and more intransigent manner. The willingness to seek political compromise is constantly decreasing. Traditional spaces for democratic dialogue such as parliaments or public gatherings are becoming less important.

So, how can the increasing political disenchantment be countered and democracy made more resilient? The constitutional law expert warns against taking legal action against democratically elected opponents of democracy, e.g. a party ban. "Democratic equality, i.e. the participation of all, is a key value. Democracy also depends on the majority of people seeing their will reflected in it. And that makes it difficult to just ban parties or their leaders when they are ahead in the polls. Even when they violate democratic rules. If we try to protect liberal democracy with authoritarian instruments, we will destroy it."

Instead, we should be reinforcing the common good and encouraging interaction between different groups in society at various levels, as democracy only works if people with different perspectives see themselves as part of a common society. Democracy is not only a political competency, but also a social competency, which needs to be learned and practiced, says Schönberger. "We need to share our lives with each other more. Every day-to-day encounter with other people strengthens our awareness that we live in a democratic community, that we are connected with each other through this community and that we bear joint responsibility for the common good. This cultivates a willingness to embrace democracy in a variety of different ways."

"Democratic equality, i.e. the participation of all, is a key value. Democracy also depends on the majority of people seeing their will reflected in it."

Professor Sophie Schönberger — legal expert

So, what needs to be done? The government has to step up. They need to utilise urban planning and construction, as well as social and education policy to organise communities and shape community life – including reliable social security and affordable housing. And the legal expert calls for the preservation, targeted creation and attractive configuration of "democratic meet-up opportunities". With reference to the ethnologist Marc Augé,

Democracy is dependent on participation: 100,000 people demonstrated against right-wing extremism and the far-right AfD political party by the Rhine in Düsseldorf in January 2024.

PHOTO HHU

PHOTO ISTOCKPHOTO – WE-GE

Pubs are neighbourhood meeting places where everyone can easily strike up a conversation, irrespective of where they come from and their role in society.

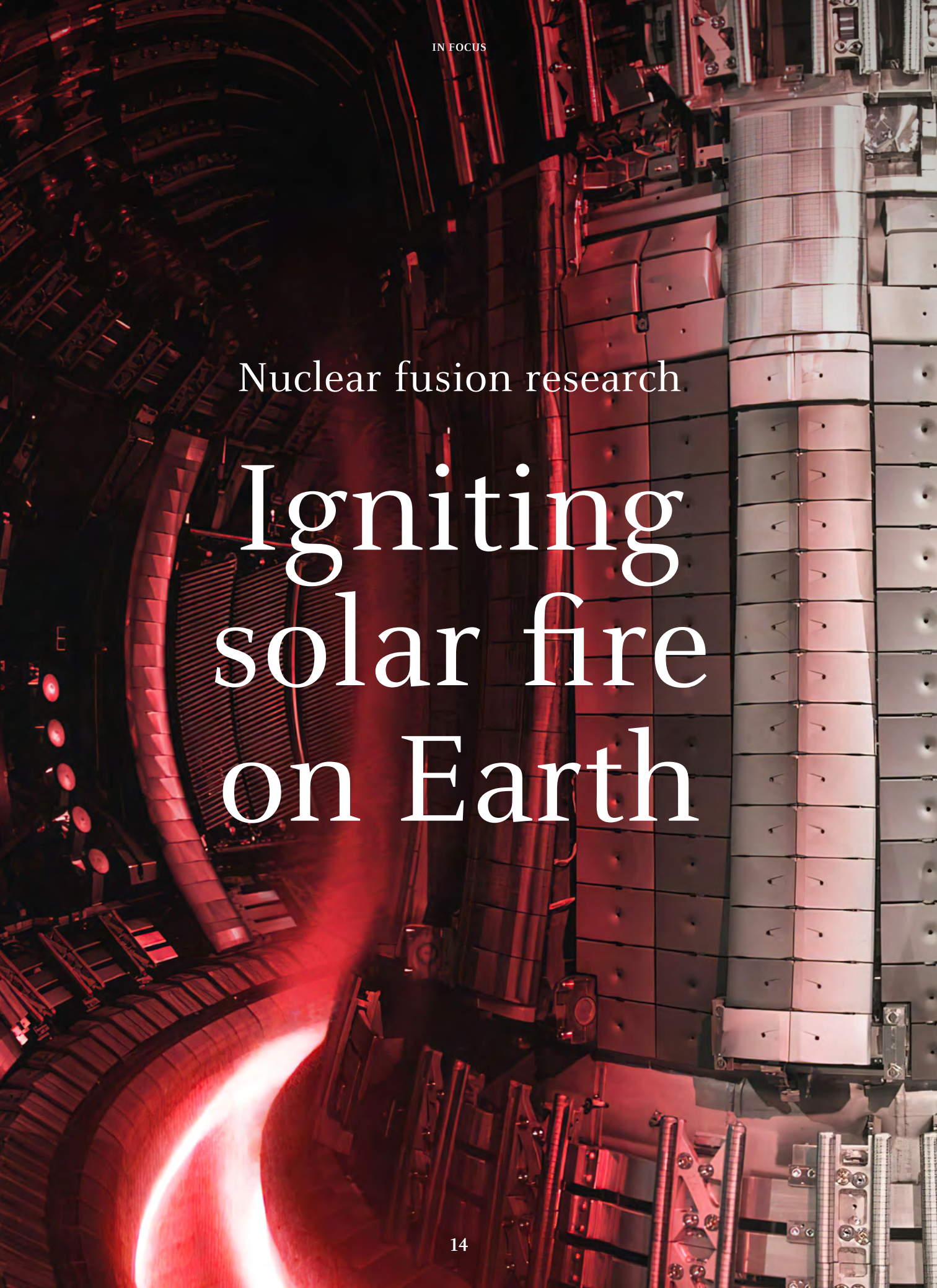
Schönberger refers to them as "anthropological places". They enable day-to-day social encounters and "get people out of their egocentric circle". They include neighbourhood meeting places such as parks, libraries, swimming pools, pubs and even the kiosks known in North Rhine-Westphalia as "*Büdchen*", which are now classified as intangible cultural heritage. These are places where people can spend time with and learn to accept others in democracy with minimal personal effort.

What keeps a community together?

When it comes to democracy, it is best to start early. So Schönberger has now written a children's book on the topic. In "*Das Parlament der Tiere*" ("The parliament of the animals"), she brings together members of parliament, majorities, elections and the search for a sustainable compromise in a story about a peach tree. All the animals in the forest covet the fruit on the tree. How should the impending chaos be averted? Ultimately, an animal parliament is established to manage the fair distribution of the peaches.

It is a way to teach young children about important social topics such as constructive debate, diversity of opinion and peaceful coexistence in an easy-to-understand and fun way. And to show how important it is that all voices are heard.

> "Every day-to-day encounter with other people strengthens our awareness that we live in a democratic community."
>
> **Professor Sophie Schönberger — legal expert**



Nuclear fusion research

Igniting solar fire on Earth

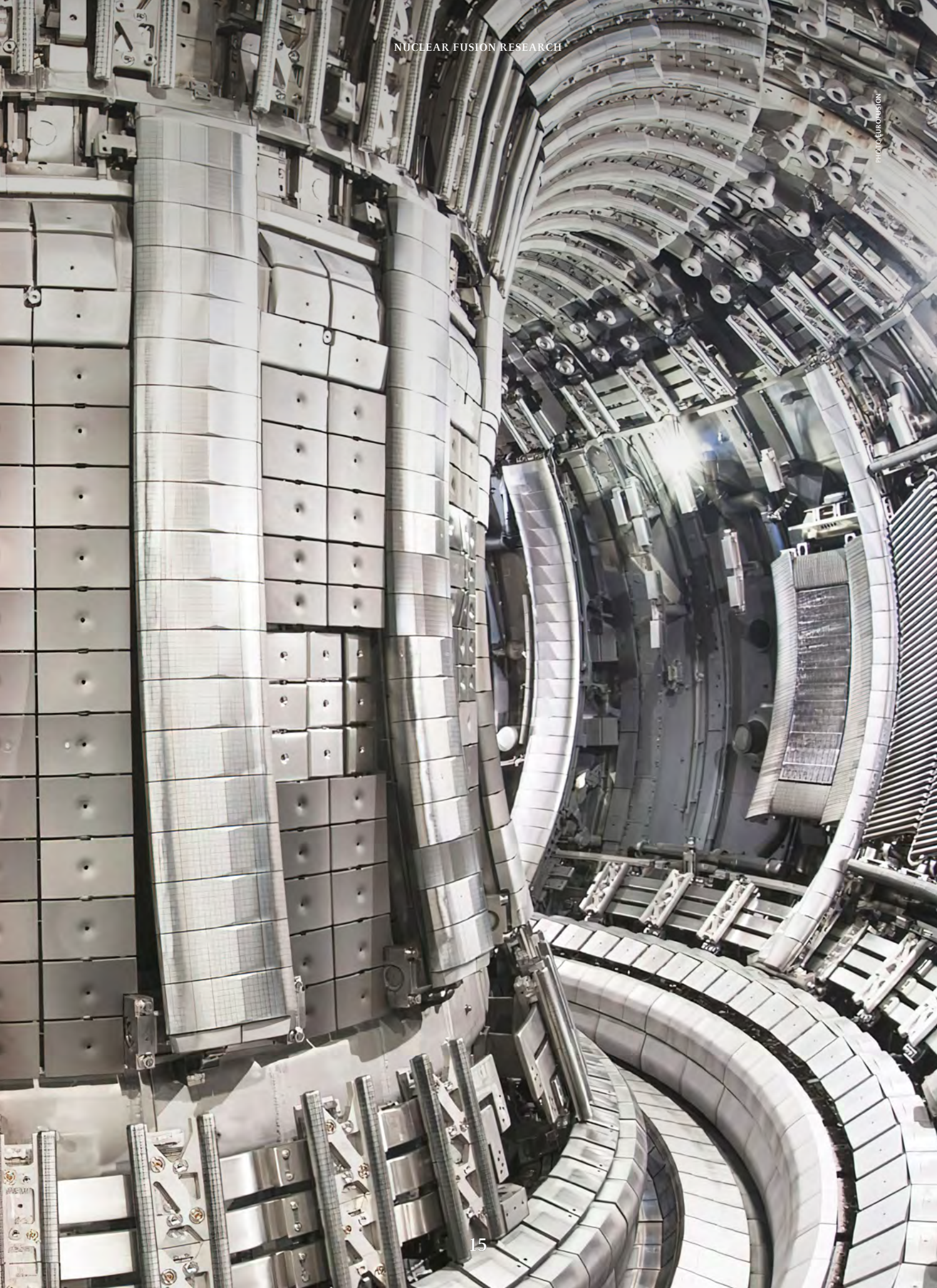


PHOTO © EUROFUSION

BY ARNE CLAUSSEN

Nuclear fusion: This is the process by which our sun and virtually every other star generates vast amounts of energy. This "stellar fire" is what makes the stars shine and its light is what makes life on Earth possible. There is no other physical process, which releases as much energy in a single event. Energy from fusion can be a key component in the energy supply of the future. However, containing fusion within a power plant is a highly complex task. Dr Sebastijan Brezinsek, Professor of Physics at HHU, and his team are examining important questions along the path to building a reactor.

In fusion, light atomic nuclei combine to form heavier ones – in the case of our sun, four hydrogen nuclei fuse to create (net) one helium nucleus. In older stars where the reserves of hydrogen in their core have been exhausted, ever heavier nuclei – up to and including iron – fuse over the course of their evolution. Nuclear fusion thus also generates the majority of elements in the universe, which largely comprised hydrogen and small amounts of helium following the Big Bang. By contrast, heavier elements than iron were only generated later in the development of the universe in supernovae.

Since the end of the 1950s, physicists and engineers from all over the world have been working to make nuclear fusion usable as an energy source. The hope is that widely available raw materials – hydrogen is the most common element in the universe – can be used to generate an inexhaustible supply of energy. However, this undertaking has proven a significantly more complex task that initially anticipated.

Creating an environment comparable with the heart of a star

To ignite and maintain nuclear fusion, it is necessary to create an environment in a reactor that is comparable with that at the heart of a star: a temperature of many millions of degrees Celsius with high particle densities. Under these conditions, the state of the matter also changes – it then exists in the form of a "plasma": a gas comprising isolated, positively charged atomic nuclei and the electrons, which originally formed the atom shells.

"Confining and further heating this hot plasma in a defined volume at the temperature, density and confinement time conditions required for magnetic fusion is an extremely complex task, which has already occupied generations of physicists," says Professor Dr Sebastijan Brezinsek.

In a joint appointment with a professorship at HHU in accordance with the leave of absence model ("Jülich Model"), he heads the department examining "plasma-wall interactions" at the Institute of Plasma Physics (IFN-1) at *Forschungszentrum Jülich* (Jülich Research Center – FZJ). The Jülich Institute is involved in many of the major fusion research experiments in Germany and abroad, including the ITER (International Thermonuclear Experimental Reactor) project under construction in Cadarache in southern France.

The currently most widespread technology on which plasma experiments like ITER and many other systems are based is the so-called tokamak. This is a ring-shaped metal vessel – a so-called torus – surrounded by various magnetic field coils. The coils generate overlapping magnetic fields, which stabilise the plasma in a ring-shaped volume inside the chamber. An induced current flow, additionally irradiated microwaves and neutral particles heat the plasma to extremely high temperatures, giving the particles the energy they need to fuse when they come into contact with each other.

Involvement in various international projects

The plasma chamber at ITER is around 11 metres high, has an interior diameter of six metres and an exterior diameter of 19 metres, and will have a plasma volume of 837 cubic metres. Until 2013, the Jülich Institute operated the TEXTOR tokamak, with which they conducted many important fundamental investigations. The

PHOTO MPI FOR PLASMA PHYSICS/JAN MICHAEL HOSAN

Mounting the graphite tiles in the plasma vessel of the so-called stellarator experiment Wendelstein 7-X at the Max Planck Institute for Plasma Physics in Greifswald.

PHOTOS: HHU / CHRISTOPH KAWAN

FZJ is also involved in the scientific use of the JET tokamak (Joint European Torus) in Culham near Oxford.

Brezinsek, who spent several years as scientific director at JET: "Fusion research has come a long way over the past few decades. Recently, record fusion energy values under relevant, integrated plasma conditions were achieved in JET, which served as a reference for the operational design of ITER. In the next step, ITER will now be used to clarify the last remaining questions in order to enable us to build a demonstration fusion reactor in the following step."

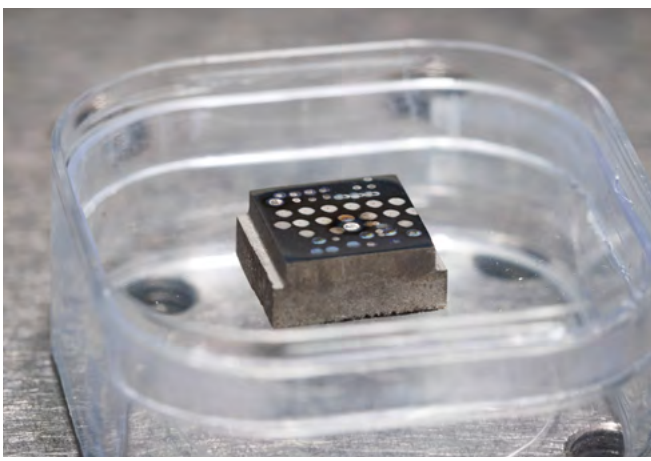
Fusing hydrogen to helium

In the planned experiments, two isotopes of hydrogen are to be fused: deuterium (for short: 2D) and tritium (for short: 3T). The former occurs naturally and can be extracted e.g. from water. By contrast, tritium is radioactive and decays with a half-life of around 12 years. It cannot be found naturally and must therefore be "bred" in the reactor first. This should take place inside the reactor chamber: In so-called blankets, neutrons from the plasma zone react with lithium on the reactor wall; the nuclear reaction produces 3T and helium.

Professor Brezinsek is particularly interested in the interaction between the plasma and the reactor wall, as well as the dissipation of energy and particles. There are critical questions to be answered: What happens when particles heated to millions of degrees from the burning plasma hit the wall of the reactor vessel? Do they dislodge material from the wall? If this wall material enters the plasma, it would impact the nuclear fusion as it cools the plasma down. How do high-energy neutrons from the plasma affect the crystal structure of the tungsten in the wall? Do fuel atoms become incorporated into the tungsten and perhaps change the structure? In this case, the fuel would no longer be available to the fusion process and could under certain circumstances impact the integrity of the plasma vessel.

"In the original concept for ITER, beryllium was planned as the coating for the inner plasma-facing wall. This light element dissipates heat well and binds oxygen. However, we observed much greater beryllium erosion than expected in

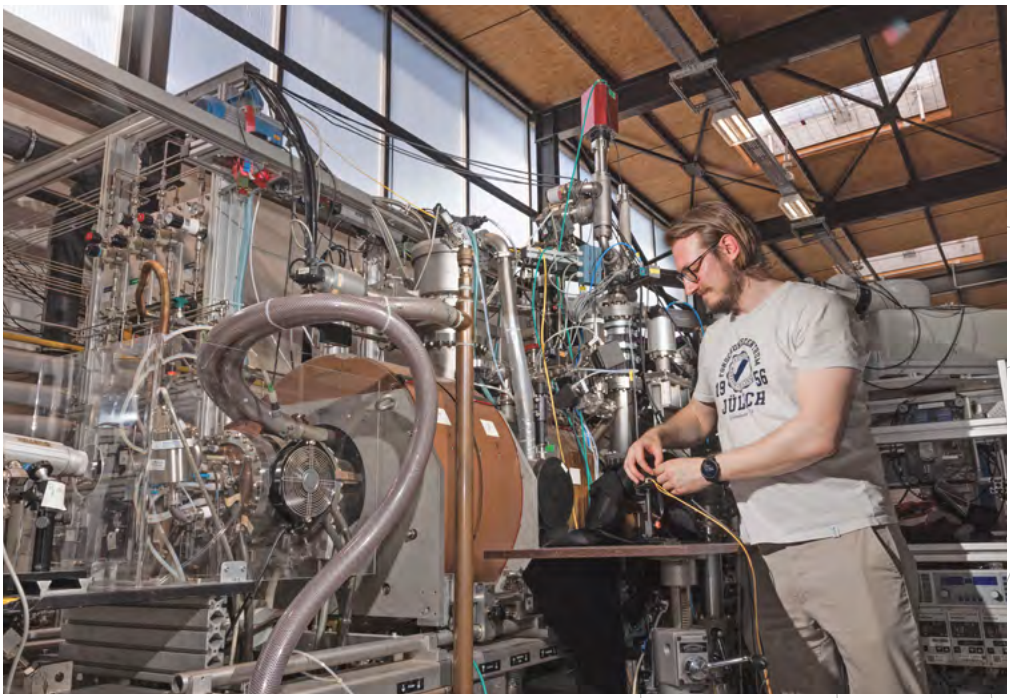
A tungsten sample examined using laser-induced plasma spectroscopy. The inner plasma-facing wall of the future ITER experiment is to be clad with tungsten.



"Fusion research has come a long way over the past few decades. Recently, record fusion energy values under relevant, integrated plasma conditions were achieved in JET, which served as a reference for the operational design of ITER."

Professor Sebastijan Brezinsek — physicist

PHOTO: ITER ORGANIZATION



Christoph Kawan, doctoral researcher in physics at HHU, connects the camera setup to the plasma system.

our experiments," says Brezinsek, commenting on the results of his research group, which were largely achieved using JET. Now, the intention is to clad the interior of the vessel with tungsten. However, this heavy element has disadvantages: If too much of it enters the plasma, it will cool down the core, with the result that the necessary fusion conditions for temperature and density will no longer be achievable.

Expanding simulation models using experiments

At the Jülich Institute, the effect of particle bombardment on the reactor vessel is being examined by means of both simulations and experiments. Among other activities, two linear plasma experiments are being conducted to establish how various material samples respond to plasma bombardment. The experiments also serve to expand the simulation models, enabling many questions to already be answered on the computer, thereby saving time and costs.

Many HHU students have already completed their master's and doctoral theses in the working group headed by Brezinsek. Christoph Kawan and Erik Wüst, who are completing their PhDs at HHU, are currently also working there. Both are working on laser-based diagnosis techniques, which could be used in a reactor in the future. "Once a fusion experiment has been started, the vessel is sealed for a long period of time and it is no longer possible to access the wall directly in order to examine it," says Kawan, explaining the fundamental issue for his research. He adds: "We need a flexible diagnosis instrument, which takes up as little space as possible. Lasers are a good choice here as they can either be pointed through windows into the interior of the reactor from outside or attached to a remote-controlled internal robot arm and pointed onto the reactor wall. We can use high-energy, ultrashort pulse picosecond lasers to dislodge tiny amounts of material from the wall on a targeted basis and examine them using various spectrometers." A picosecond is a millionth of a microsecond, meaning that a great deal of energy is transported in a single laser pulse in an extremely short period of time.

"It is important that we not only see the outer layers of the wall, but also that we see what is happening deeper within the wall," says his colleague Wüst. "With our laser-induced plasma spectroscopy, we can also measure how various isotopes are distributed at different depths in the reactor wall. This provides information about the deposition mechanisms."

Christoph Kawan is seeking to find out whether picosecond laser pulses are the best choice for the mass spectrometry and which physical processes dominate over optical spectrometers. "Comparatively long nanosecond pulses heat the wall material to a much greater depth, meaning that they can thermally expel hydrogen from the wall. With shorter pico- or femtosecond pulses, such disruptive effects are much less severe or even non-existent. However, this also influences the resulting craters, the plasma parameters and the interactions between any dislodged particles and the surrounding environment," says Kawan.

The Federal Ministry of Research, Technology and Space has launched a major research programme called "Fusion 2040" with the goal of building a demonstration reactor by 2040. Funding of 400 million euros will be provided over ten years. Brezinsek: "This is a concrete technology programme aimed at answering the various questions of importance for an electricity-generating reactor. For example, exactly how the 3T can be bred in the reactor wall, how the energy can be discharged from the reactor and how the reactor can be operated in a sealed state over a period of years."

Climate-neutral power supply

So, it will still be decades before we have a fusion power plant. Can such power plants contribute to generating a climate-neutral power supply? "In the first instance,

Erik Wüst, a doctoral researcher whose supervisor is Professor Brezinsek, fine-tuning the optics for the picosecond laser plasma spectroscopy.

"In the first instance, the operation of a fusion power plant is climate-neutral, i.e. no carbon dioxide is emitted. This can make it an important component for a CO_2-neutral energy supply."

Professor Sebastijan Brezinsek — physicist

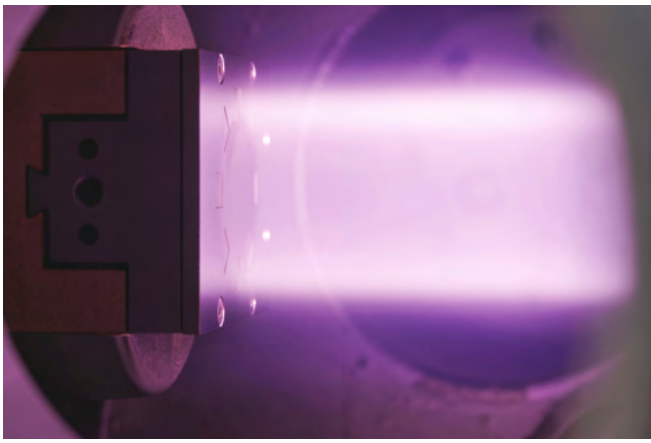
PHOTO FZJ/RALF-UWE LIMBACH

Professor Sebastijan Brezinsek conducts research at the Institute of Fusion Energy and Nuclear Waste Management (IFN) – Plasma Physics (IFN-1) at *Forschungszentrum Jülich* in a joint appointment with a professorship at HHU in accordance with the leave of absence model ("Jülich Model").

the operation of a fusion power plant is climate-neutral, i.e. no carbon dioxide is emitted. This can make it an important component for a CO_2-neutral energy supply," emphasises Brezinsek. "In addition, it is operated using fuels that are widely available all over the world, making us independent of suppliers. The collapse in natural gas deliveries at the start of the war in Ukraine demonstrated how important this is."

Fusion power plants in the future energy mix

In comparison with current nuclear power plants, fusion power plants are a safe and comparatively clean technology: As soon as the plasma is extinguished, there are no further nuclear reactions. Although the wall material is activated – by neutrons, which form during the fusion reaction – materials with rapidly decaying radioactivity will be selected. The goal is for it to be possible to handle the materials after 100 years, i.e. that their residual radioactivity is so low that it does not represent a hazard to people and the environment. Although a great deal can be achieved through regenerative energy sources, they are not enough to cover the constantly rising global electricity requirements in full and at all times. Sufficient reserve capacities must be available. Professor Brezinsek is confident: "Fusion power plants are ideally suited to ensuring a secure basic load supply. They represent an important component for the energy mix of the future."



The deuterium plasma strikes a plate holding samples arranged in a ring (left). The aim of this is to examine how the wall material in a future reactor will respond to plasma bombardment.

LEGO® in higher education didactics

Learning abstraction with colourful bricks

PHOTO ISTOCKPHOTO – IVELIN DENEV

BY VICTORIA MEINSCHÄFER

A Wednesday morning in April, 8.30 a.m., building 24.21, 1st floor: I am sitting with Peter Bernardi in his office at SeLL (Service Center for Good Teaching and Learning) and have been invited to a play session. With LEGO®. Which really is as much fun as it sounds, even though the idea has a serious background: SeLL has been offering seminars in LEGO® SERIOUS PLAY® since 2023 and also lends corresponding materials to lecturers at HHU: 100 bags, each containing 56 different LEGO® bricks.

Two Swiss economists developed the method in the nineties," says Bernardi, "with the aim of implementing new strategy development methods." My serious play session starts with a simple building task. Bernardi gives me just one minute to build the highest possible tower. The fun factor of an unfamiliar game and the time limit provide all the motivation I need to stack as many bricks as possible carefully on top of each other. This is something Bernardi experiences time and again, and above all something the lecturers who use the LEGO® in their seminars experience: The unusual activity is motivating, breaks the ice and gives you the opportunity to experience a "flow" moment. The next task already awaits me: I have to build an animal using just eight bricks – and I only have two minutes to do so. My hands move quickly and a dog ends up standing on the table. Now – in both my session and above all in the classes – it is time for the next phase: presenting your results and viewing those of the others. I am amazed that Bernardi cannot immediately recognise that my rectangular green, yellow and grey bricks are a dog, and learn here that my perspective on my work – and of course on a problem to be solved,

Respecting different perspectives

e.g. in the seminar – is just as good or bad as those of others. Bernardi would have accepted it if I had declared my dog to be a crocodile on land: "That is exactly what the participants learn when using the LEGO® – how to present their position and explain their approach. Which is good e.g. in groups, where there are always some more reticent participants: The situation gives them a chance to speak up and present their position. It is easier

Build first – then explain. Through LEGO® SERIOUS PLAY®, the participants also learn to explain their position and defend their approach.

PHOTOS SELL

When the lecturers place the task in the right context, the colourful bricks can be used to create virtually anything.

for people to overcome their inhibitions in a group than when answering a question from a lecturer."
The tower and the animal were just the warm-up to give the participants a chance to familiarise themselves with the materials and break the ice. In the next steps, the colourful bricks can be used for almost any purpose.

Not just imparting knowledge

The only important thing is that the lecturer puts the task in the right context. Then, possible tasks can range from "build how you imagine a sustainable HHU" to "build a model of democracy". In the experience of Bernardi and his colleague Dr Elisabeth Scherer, the bricks can be used in all subjects – and they report that they have already lent them to the English Studies and Romance Languages and Literatures departments, as well as the Biology department and the Medical Faculty. Although they are naturally less suited to the direct imparting of knowledge, they are ideal for reviewing whether a topic has been understood and for reflection processes.
In the SeLL seminars, the lecturers who want to use the LEGO® learn above all that it is important to plan the teaching unit thoroughly: It should be clear from the outset, which tasks are to be completed, whether they should be individual or group tasks and what the participants should learn from the experience. Bernardi provides an example from the Biology department: "The students' first task was to read three different sets of instructions for an experiment. Then they had to build an experiment setup using the LEGO® bricks and explain it to their fellow students. The presentation enables the lecturers to see how well the students have understood the setup and where their own (unconscious) focuses lie." Like all SeLL seminars, the LEGO® training is available to all HHU lecturers – either as part of the "Professional Teaching Skills for Higher Education" certificate programme or as an individual workshop. And the bags for use in the seminar can simply be borrowed from SeLL.

> "The situation gives them a chance to speak up and present their position. It is easier for people to overcome their inhibitions in a group than when answering a question from a lecturer."
>
> **Peter Bernardi — higher education didactics expert**

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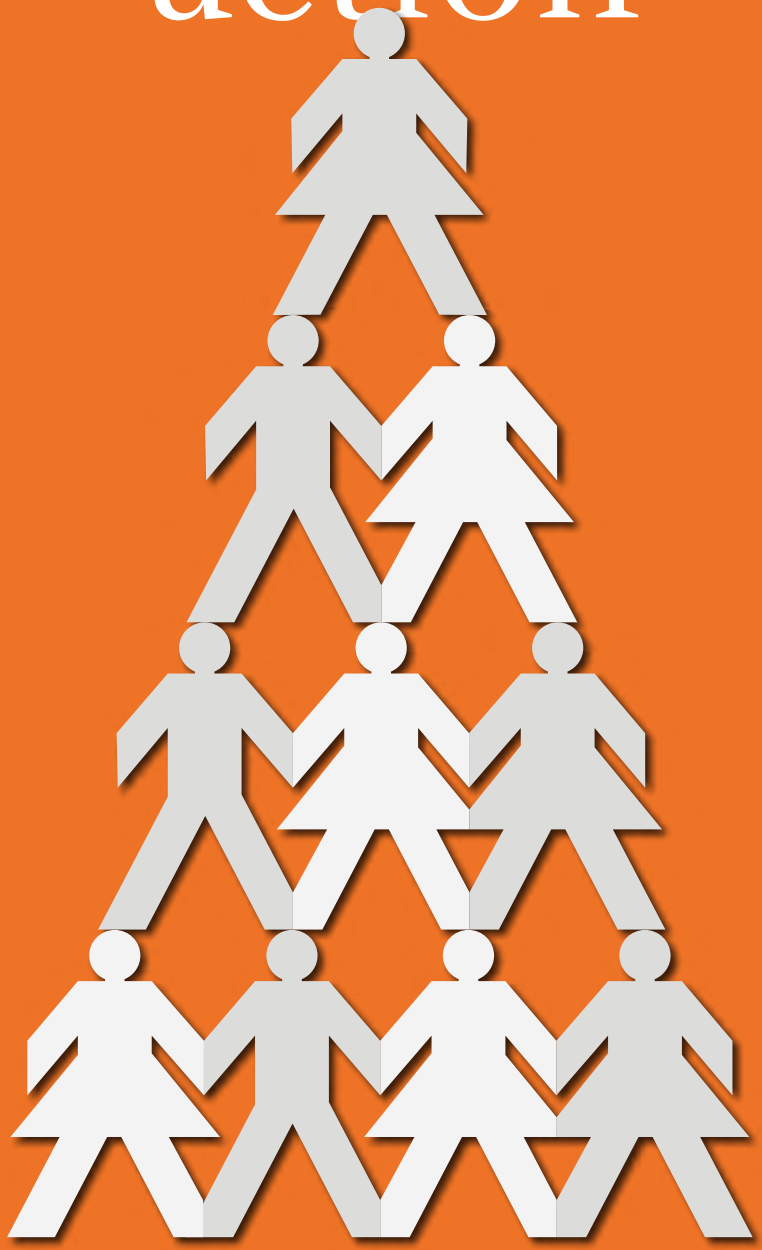
Affirmative action



Under which conditions are (women's) quotas successful?

ILLUSTRATION ELI ALAIMO DI LORO

BY CAROLIN GRAPE

Quota regulations count as "affirmative action". This term refers to political measures aimed at improving equal opportunities and compensating for structural disadvantages. Certain groups (e.g. women or members of ethnic groups) are given preferential treatment in the case of admission to studies, recruitment or promotions. The economist Professor Dr Hannah Schildberg-Hörisch examines who rejects or is in favour of quotas and for what reasons. And what that means for the effectiveness of the quotas.

Quotas are controversial and often the subject of fierce debate. On the one hand, they can promote diversity in companies but, on the other hand, they can also have a counterproductive effect and trigger feelings of injustice. However, broad support is crucial for the implementation of such measures – it is the only way their full potential can be realised and negative reactions against the recipients of the preferential treatment avoided.

In order to maximise the effectiveness of such a policy, a better understanding of the factors, which influence attitudes to affirmative action is necessary. And this is exactly what Hannah Schildberg-Hörisch, Professor of Behavioural and Empirical Economics, has examined empirically with her team in various research projects. She emphasises: "Quotas always apply in situations involving competition. There are usually winners and losers – a risky situation. The more people support the quota, the greater the probability of its successful implementation. Accordingly, in order to win people over, it is relevant to know who is for or against quotas and for what reasons."

Empirical studies

To this end, the researchers conducted an online experiment in the laboratory. The students had to determine the exact number of zeros in a 10 x 10 table containing ones and zeros within a fixed period of working time. The participants were randomly assigned two multipliers – 1 versus 0.9. In the case of 0.9, the actual performance, i.e. all tasks completed correctly within the period of working time, was downgraded – a very clear and unjustified form of discrimination. This stylised environment enabled the research team to examine perceptions of quotas. In particular, they analysed the role of selfish motives and in-group favouritism in approval. The results were combined with survey data on a range of further potential influencing factors.

The result: Selfish motives have a strong influence on acceptance of a quota – people who profit directly from a quota themselves are more likely to support it than those who experience worse competitive conditions as a consequence of its implementation. "It is not really surprising that selfish motives play a key role. Nevertheless, it is important to provide evidence of

> "The quota has the effect of motivating highly qualified women in particular to throw their hat into the ring."
>
> **Professor Hannah Schildberg-Hörisch — economist**

this as people rarely admit it publicly. What is surprising, however, is that the support of one's own group, so-called 'in-group favouritism', is significantly less important," says the researcher. This is good news in times of polarised societies.

According to the study, socio-demographic factors such as income or education have very little influence. Younger individuals who are politically oriented toward the left and have an altruistic attitude tend to see quota regulations as a good thing. Older, more conservatively oriented individuals with a higher income are more likely to reject them.

One core finding, which is surprising: Individual personality traits such as altruism and a preference for efficiency play a key role. How justified the individual perceives the quota to be also plays an important role in whether they support it. Interestingly, people who have little personal experience of discrimination are more in favour of quota regulations where they consider them to be fair equal opportunities measures. Quotas also enjoy greater support when they genuinely create fair starting conditions and promote economic efficiency. "And, the more justified individuals believe a quota to be, the more willing they are to participate in competitive selection procedures – in particular also those where they will not experience preferential treatment. This increases the pool of applicants. It is often documented that the quota ultimately results in a better qualified person getting the job than would be the case without the quota."

The researcher makes reference to experiences with the women's quota and comments: "Women are more averse to risk, rate their performance less highly and find competitive situations less attractive than men. This is why they are likely to be more hesitant to apply. The quota has the effect of motivating highly qualified women in particular to throw their hat into the ring." This effect contrasts with the frequently raised concerns that the quota results in less qualified individuals succeeding. "There is usually no significant negative correlation. In fact, the opposite is more likely. Emphasising the positive consequences of affirmative action can therefore be helpful."

Perception of fairness is key to acceptance

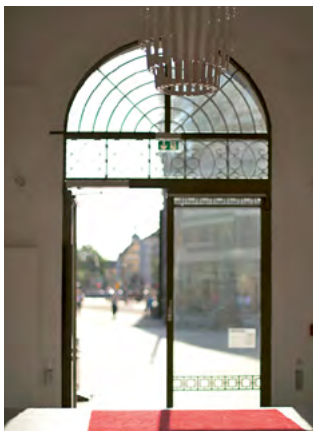
Conclusion: Whether a person is in favour of measures depends on the one hand on the fundamental convictions of that person. On the other hand, egotistical motives play a significant role. The importance of self-interest in the formation of an opinion suggests that affirmative action, irrespective of the form it takes, will always have supporters and opponents, and remain controversial.

However: Quota regulations gain greater support when they are perceived as justified and their introduction is well-founded. The expert recommends: "It is crucial to provide accompanying information, which explicitly explains why the measure compensates for discrimination and how it creates equal opportunities in the specific case." This can diffuse concerns about effectiveness, increase the perception of fairness and potentially have a positive effect – all good prerequisites for success, according to the results of the study.

MORE INFORMATION

→ **Herzog, Sabrina, Hannah Schildberg-Hörisch, Chi Trieu, Jana Willrodt. Who is in favor of affirmative action? Representative evidence from an experiment and a survey, IZA DP 16640.**

Heinrich Heine University Düsseldorf



Haus der Universität

The *Haus der Universität* is a place of dialogue and exchange between science and society – in the heart of Düsseldorf. After extensive renovations, the van Meeteren Foundation kindly allowed Heinrich Heine University to use the building at Schadowplatz 14 as an event centre and, since 2013, as a venue for scientific conferences and for presenting university research and teaching as well as academic culture. The *Haus der Universität* takes on a central function for Heinrich Heine University at the interface between science and the public. It is part of the higher-level public engagement strategy being pursued by the university, which actively furthers the exchange between the city of Düsseldorf, its citizens as well as society as a whole.

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