

Making transistors a thousand times faster

A new group for young researchers is being set up at the Oldenburg University's Institute of Physics. The Federal Ministry of Education and Research will provide Dr. Martin Silies with around 1.2 million euros in funding over a four-year period so that together with two colleagues he can develop an all-optical, nanotransistor capable of ultra-fast switching. Everyday electronic devices all feature transistors. Nowadays these electronic switches measure just a ten-thousandth of a millimetre, and millions of them can be incorporated into a single processor. It is, however, almost impossible to make them any smaller, and the size of the components limits

the speed at which a switch can open and close.

Silies' research may be able to increase current clock speeds of a few gigahertz (several billion cycles per second) by more than a thousand times, which could considerably boost the speed of mainframe computers and other technology in the future. The 35-year-old scientist's objective is to control specific light particles, called photons, with such precision that they can be used to operate all-optical transistors. In this process the distance between the tips of two extremely fine, converging gold wires is just a few nanometres (one millionth of a millimetre). Silies' research group

hopes to be able to control the process of photons crossing this almost inconceivably small distance – thus closing the switch – at almost unimaginable rates using dye molecules. Depending on these molecules' degree of light saturation they either allow a photon to pass or block the shutting of the switch.

With his team of doctoral candidates Silies plans to work initially on the delicate gold antennas into which extremely fine lines are carved using helium ions. The lines guide the photons. The team will also be testing interactions between different dye molecules and potentially also other molecules on this tiniest of all scales.

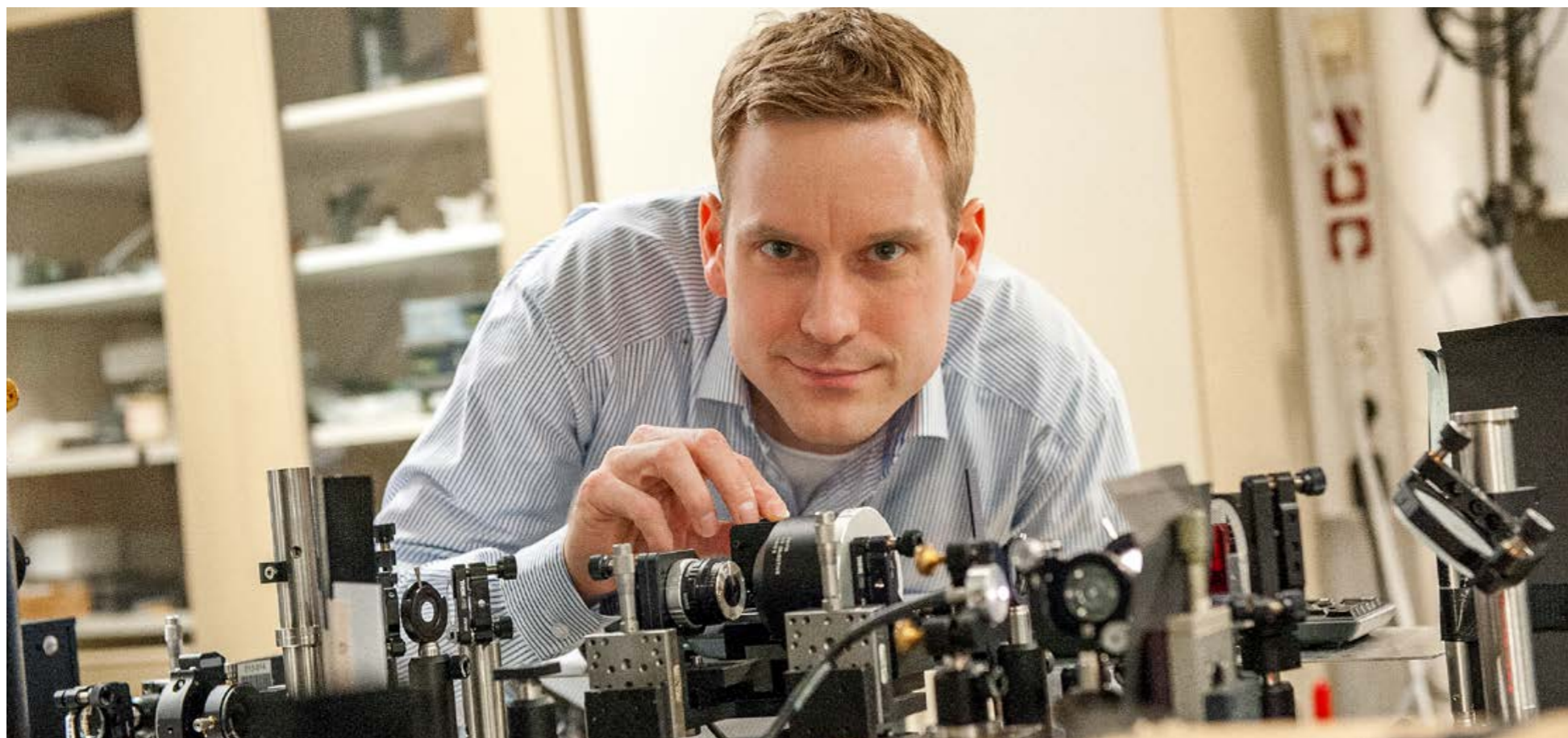
Successful sustainability research

The University was successful with not just one but two applications for project funding from the "Science for Sustainable Development" funding programme of the State of Lower Saxony and the VolkswagenFoundation. Oldenburg scientists are also involved in two other research projects on sustainability that were approved for funding. The new programme will provide around 12 million euros for eight projects in total.

"Reflexive Responsibilisation. Responsibility for Sustainable Development" is the title of a research project led by Oldenburg sociologist Prof. Dr. Anna Henkel. The sociologists, economists and philosophers involved in the project aim to uncover obstacles

on the path to a sustainable society and anticipate consequences. "Resilience of Socio-Technical Systems exemplified using the Electricity Transport and Actor System" is the title of the second project, which is based in Oldenburg and led by Prof. Dr. Ulrike Feudel, a physicist. Resilience here refers to the ability of a system to maintain key functions even when malfunctions occur. The energy systems of the future must for instance be resilient against climate change, but also against fluctuations in wind energy input. In this project economists, physicists and sociologists will research interactions between complex networks. Computer scientists and environ-

mental economists from Oldenburg University and its affiliated OFFIS Institute are also conducting research on energy supplies for the future in the project "NEDS – Sustainable Energy Supply Lower Saxony", which is based at the University of Hannover. And in the project "Sustainable Consumption of Information and Communication Technologies (ICT) in the Digital Society – Dialogue and Transformation through Open Innovation", based at Osnabrück University of Applied Sciences, computer scientists specialising in the environment and sustainability are joined by economists from Oldenburg in conducting research aimed at improving sustainability in technology consumption.



Martin Silies is developing tomorrow's technology for use in ultra-fast "optical computers".

Increasing wind turbine efficiency

Although high-quality wind turbines are already being produced today, the goal is continual improvement. The "ventus efficiens" research project based at the Universities of Oldenburg and Hannover in the ForWind Center for Wind Energy Research, is aimed at boosting efficiency in wind turbines. The VolkswagenFoundation is providing an initial 3.6 million euros in funding for the project. Unlike at the turn of the millennium, when scientists were concentrating

on optimising individual wind turbine systems, the focus today is on wind energy production as a whole. The researchers want to improve efficiency along the entire production chain: from energy conversion to the bearing structures and drive trains all the way to the power grid connections. By reducing electricity costs, extending the service life of turbines and improving the quality of their output the project is aimed at helping upgrade the European energy system.

"Smart Cams" and public life

"Smart cams", small intelligent cameras built into everyday objects and permanently connected to the internet, may soon completely digitise life in public spaces. Legal scholars and social scientists at Oldenburg University working together with computer scientists from the university's affiliated OFFIS Institute analysed the tech-

nological opportunities, potential for social conflict and need for legal regulations that come with this technology in a two-year project called "ChaRis-ma". The Federal Ministry of Research and Education is providing just over 400,000 euros in funding for the project, which is led by professor of legal informatics Prof. Dr. Jürgen Taeger.



A team of five researchers and several students participated in the laboratory experiment. The samples were prepared and analysed using ultra-high resolution chemical methods.

Bacteria in the ocean: vital for the global carbon cycle

How can organic matter dissolved in the ocean store carbon over thousands of years and maintain our climate in the process? To shed light on this question, marine scientists at the University of Oldenburg performed a laboratory experiment over several years.

The team of five researchers led by Dr. Helena Osterholz and Prof. Dr. Thorsten Dittmar of the Institute for Chemistry and Biology of the Marine Environment (ICBM) published its findings in the prestigious journal "Nature Communications".

The ocean stores similar amounts of carbon in dissolved organic matter (abbreviated to DOM) as are present in the carbon dioxide (CO₂) in the Earth's atmosphere. The mixture of various carbon-containing substances consists of the products of metabolism and decomposition of marine organisms such as algae. DOM forms the basis for the survival of marine bacteria, which during the degradation of these compounds release part of the carbon they contain into the atmosphere in the

form of CO₂. However, a large proportion of the DOM remains in the seawater for several thousands of years, some fractions have even been found to reside in the water for up to 40,000 years. Consequently this so-called refractory DOM - also known as RDOM - functions as a huge, long-term carbon depot.

The question of whether RDOM is created through biological processes alone, and if so, of how it can resist bacterial decomposition for so long forms the basis of the publication. To answer these questions the researchers mixed pure, initially DOM-free seawater from the North Sea, including its natural algae and bacterial assemblages. Taking water samples over a period of 1011 days, they were able to observe algal growth, DOM release and decomposition processes and perform detailed analysis applying ultra-high resolution chemical methods.

The researchers examined whether the compounds produced in the laboratory were of the same molecular

composition and present at similar concentrations as those in the deep sea across the globe. The result: the molecules were for the most part the same as those found in marine RDOM, but were present in very different concentrations. The ratios of the different DOM components in the laboratory were not identical to that of oceanic RDOM.

In complex calculations the scientists determined the percentage of RDOM present in all the organic material produced in the experiment; it constituted 0.2-0.4 percent of the entire fixed carbon. "In this experiment we were able to experimentally show what has long been suspected: biological processes suffice to keep the amount of carbon stored in the ocean at stable levels," Osterholz explains.

A fragile balance that Osterholz says is highly relevant for our climate: "In the history of our planet even small variations in the concentration of oceanic dissolved organic matter have probably led to global ice ages or interglacial periods."

Interdisciplinary dialogue: the grand opening of the NeSSy research building

The new NeSSy research building provides space for 80 researchers working in the "Hearing4all" Cluster of Excellence and those areas where the research centres for Neurosensorics and Safety-Critical Systems intersect. Around half of the building's 2000 square metres of floor space is taken up by laboratories containing high-tech instruments for advancing interdisciplinary basic and applied research. These include acoustics and hearing labs as well as neurophysiology laboratories.

The scientists' research focuses on in-

novations in medical technology and human-machine communication. The building houses extremely valuable research instruments such as a magnetoencephalograph scanner, a functional MRI scanner and a "3D Virtual Reality" laboratory, as well as a conference centre. The federal government and the government of Lower Saxony shared the building's total cost of 15 million euros. At the opening ceremony of the NeSSy building guests were given an insight into the ongoing research in an interactive tour of the laboratories featuring live interviews with scientists.

Science study: homogenising biological communities

Humans are introducing increasing numbers of plant and animal species into new areas. An international team of researchers led by Prof. Dr. Henrique Miguel Pereira of the German Centre for Integrative Biodiversity Research in Leipzig has now demonstrated that the global anthropogenic transfer of species is causing the collapse of independent dissemination patterns that evolved over millions of years - with the result that different ecosystems are becoming more and more similar. Ecologist Dr. Hanno Seebens of Oldenburg University's Institute for Chemistry and Biology of the Marine Environment (ICBM) was one of the members of the research team who authored the study. Together with scientists from Portugal, Austria and Germany he examined 175 species of snails in 56 countries. The results of this large-scale study were published in the renowned "Science" journal. The study provides one of the first analyses of the global homogenisation of ecosystems.

"We were able to prove that regions that

are separated by great distances but have similar climates, like for example Austria and New Zealand, have very similar communities of non-native snails. This means that the biological communities are becoming increasingly homogenised," Seebens said. He went on to explain that whereas in the past similarity patterns were determined by distance, nowadays climate in combination with global trade are the decisive factors. The more intensive the trading between countries with similar climates, the more similar their biological communities become. "This biological homogenisation could have far-reaching consequences," Seebens warned. The fact that humans are introducing new species all over the world puts many native species against the intruders under massive pressure, eventually killing them off completely, he explained. "The study shows that the introduction of ever more non-native species into new regions must be stopped if we are to ensure the survival of our ecosystems."

DFG research units to continue their work

The Research Unit "Horizontal Europeanisation", which analyses how European societies are growing together, has secured funding from the German Research Foundation (DFG) for another three years. The DFG approved an additional 2.8 million euros in funding for seven sub-projects. Renowned scientists from nine universities are participating in the Research Unit, which is coordinated by Oldenburg sociologist Prof. Dr. Martin Heidenreich.

This Research Unit focuses on so-called "horizontal Europeanisation", which refers to the social integration and socio-cultural assimilation processes that are transcending national borders within the EU. The sub-projects are researching areas such as higher education systems, asylum administration structures, collective wage agreements and the different dimensions of social inequality.

Since 2012 the Research Unit "Individualised Audiology", coordinated by Oldenburg University, has pursued the goal of improving "hearing for all" with technological and psychoacoustic solutions. The German Research Foundation (DFG) will provide the Research Unit, led by Prof. Dr. Birger Kollmeier and Prof. Dr. Volker Hohmann, with a total of 1.95 million euros in funding for another three years. "The work and results of this Research Unit are among the world's best in the field of audiology," the letter of approval from the DFG stated. In addition to the Department of Medical Physics and Acoustics of Oldenburg University the HörTech Centre of Competence and the Jade University of Applied Sciences, in cooperation with the Fraunhofer Project Group Hearing, Speech and Audio Technology, are also involved in the project. The Unit's research activities represent the technological core, as it were, of the "Hearing4all" Cluster of Excellence.