ETH
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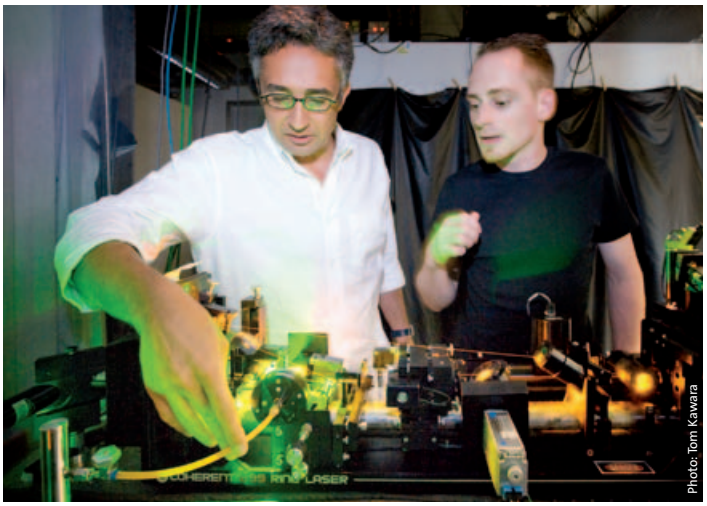
PRESIDENT'S SELECTION

The Newsletter from the ETH Zurich President

www.ethz.ch

HIGHLIGHT

"It just happened"



In the laser laboratory: Professor Vahid Sandoghdar with doctoral student Martin Pototschnig.

A research team at ETH Zurich has achieved a breakthrough in quantum physics: scientists have succeeded in producing an optical transistor from a single molecule – a fundamental step towards the quantum optical transmission of signals. Professor Vahid Sandoghdar of the Laboratory of Physical Chemistry explains what acts as a motivation and a driving force for his group.

Mr. Sandoghdar, the first working electronic transistor was presented at Bell Labs more than 60 years ago. Now, you've demonstrated that an optical transistor comprising just one molecule also works. Why has this quantum leap in basic research only just taken place?

The concept of the optical transistor has been known for a long time, we just couldn't test it on the scale of individual molecules until now. Special methods are required to detect single molecules, and these only became available in the early 1990s. Technologically, our experiment could have been carried out five years ago. So why did we succeed right now? It's hard to say – it just happened.

Do you have a special recipe for success? Can you tell us the secret?

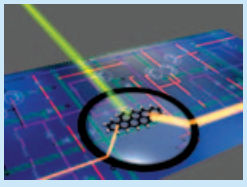
If there is a secret, it's the same one that exists everywhere in science. In the end, it's continual learning that propels us forward. We also need the ability to dream, and have a healthy measure of imagination and enjoyment. We researchers are often inspired by things that can't be rationally explained in every sense. However, success also depends on the availability of a team containing the best people, in both technical and personal terms.

And how do you get ahead of the fierce competition?

There is one crucial principle at work here: we have to come up with our own solution to the problem – not pursue existing ideas like everybody else. This is what keeps competitors at a distance – there just aren't any competitors in that kind of situation. We are very much on our own, which requires a suitable level of self-confidence, patience, persistence and courage. In the end, however, we also need money. We are therefore grateful for the financial support we receive at ETH Zurich.

What applications do you envisage for the optical transistor?

Right now, industrial applications are still a long way in the future. This experiment has to be carried out at minus 272 degrees Celsius, but it opens certain doors to future usages – maybe in the area of quantum computing, in about 20 years from now.



The optical transistor

Rather than using an electrical current (electrons), light signals are switched and amplified using a light beam (photons). The advantage: photons not only generate much less heat than electrons, they also allow substantially higher data transmission rates.

The ETH Zurich optical transistor comprises a dye molecule, the quantum state of which is altered by means of laser light so that it acts as a switch and an amplifier.

EDITORIAL

Honest Broker

Dear Reader,

Climate change, an aging society and a secure supply of food: the universities face a formidable challenge in future problems such as these.

As well as first-class teaching and research, and the efficient transfer of technology into industry, we also need new concepts that will allow us to convert the science into reality in society.

ETH Zurich takes on board a special function within this process. As a forward-thinker, it must assume the role of Honest Broker. Its function as an unbiased mediator allows the university to contribute its solution-oriented expertise, and to block off ideological blind alleys. Its duty is not to suggest rigid concepts, but to point out various options for action, along with their advantages and disadvantages.

I wish you an interesting read, a Happy Holiday and a good New Year.

R. Eichler

Prof. Dr. Ralph Eichler,
President of ETH Zurich

"QUOTE ... UNQUOTE"

"Switzerland can only win the climate protection effort if it gets going quickly, and is fully committed."

Konstaninos Boulouchos, Professor at the Energy Science Center, in the ETH climate debate on 12th November, and in the ETH climate blog (www.klimablog.ethz.ch)

RISK RESEARCH

Typhoons can be simulated in real time (this example is in Manila).

Storms in the model

ETH researchers have developed a model that provides better calculations for typhoons. These can be used by the authorities as the basis for decisions about risk-reduction and evacuation measures, thus helping to save money.

Typhoons sweep across the Pacific region repeatedly during the autumn months, wreaking terrible destruction. An ETH team led by Michael Faber, Professor of Risk and Safety at the Institute of Structural Engineering, develops models that simulate the progress of a typhoon in real time, and update it with the latest information.

These models can help political decision-makers reach risk-reduction decisions at the right time. Measures such as evacuations are risks in themselves, and are associated with considerable costs: for example, a refinery can be shut down within a day, but it takes a month to start it up again.

These research activities will still take about three more years, and a great deal of data processing will need to be done before the application can be put into practice. The researchers use their own networks, and platforms such as the World Economic Forum.

ELECTRONICS

Super-transistors

We need ultra-fast transistors so that we can process ever-increasing volumes of data. Researchers at ETH Zurich have recently improved the World Record for transistor speed by several times for aluminum gallium nitride devices built on silicon. These transistors use low-cost silicon wafers as a substrate, and are attractive to the consumer electronics sector.

Transistors are small semiconductor electronic components that can switch the flow of electrons on and off. The faster a transistor switches, the more information is processed in a given time.

Within the past few months, a research group working with Colombo Bolognesi, Professor at the ETH Institute of Electromagnetic Fields and Microwave Electronics, has repeatedly broken the record for transistor switching speed – which now stands at 108 Gigahertz (GHz) for aluminum gallium nitride on silicon.

Transistors are four times as fast

"Other research groups have so far only achieved 28 GHz with similar technologies, so we are almost four times faster," said a pleased Bolognesi. The researchers combine ultrathin semiconductors together in different layers so that the electrons flow through the material as quickly as possible. They also reduce the size of the transistors so that the electron travel times are minimized.

In consumer electronics, the price of components plays a role as well as their performance, so Bolognesi's team has been investigating transistors built on silicon. Silicon is cheap because it is widely available in nature. These transistors could be used in automobile anti-collision radars, for example, or in mobile telephone infrastructure.

LATEST

A rush on ETH

2,548 students started their bachelor degree programs at ETH Zurich in the autumn semester of 2009. This represents an increase of 15 percent compared with 2008. Mechanical engineering is particularly popular, with 482 new entries (+ 37%). For the first time ever, more than 15,000 students are now registered at ETH.

Involvement in Asia

ETH Zurich, the National University of Singapore and the Nanyang Technological University have set up a joint platform for urban development in Singapore. Architects and scientists will use a holistic approach to research the phenomenon of the "city" at the "Future Cities Laboratory".

Innovation produces results

Businesses grow more robustly when they are based on innovation rather than a large number of massive takeovers. A study carried out by ETH Zurich and the University of St. Gallen confirmed this theory. Yields are twice as high when growth is driven by innovations from within the business.

ETH RESEARCH IN THE PICTURE: SAFER PARAGLIDING

Until now, the behavior of a paraglider in the wind has been hard to predict. Christoph Wartmann, Chair of CAAD (Computer Aided Architecture Design), has developed minicomputers for the precise measurement of the most important parameters.

Sensor nodes fitted in the paraglider cap (center) send information about air pressure, acceleration and flow in real time to the vibration motors built into the gloves. These react to the data, enabling dangerous situations to be avoided during the flight.

FINAL WORD

Highly-praised wine

When a host serves wine, he or she should praise it before the guests take a sip. An ETH study has shown that wine tastes better when expectations are high. Wines rated as excellent by experts are evaluated as significantly better by the testers who were aware of the experts' assessment in advance.

No research has been carried out as yet into whether these effects apply to universities too, but it is a matter of some interest. It's certainly well recognized that a significant number of universities want to link up to ETH Zurich and appear together under a common label.

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