

PRESIDENT'S SELECTION

The Newsletter from the ETH Zurich President

www.ethz.ch

HIGHLIGHT

Dosages by body clock

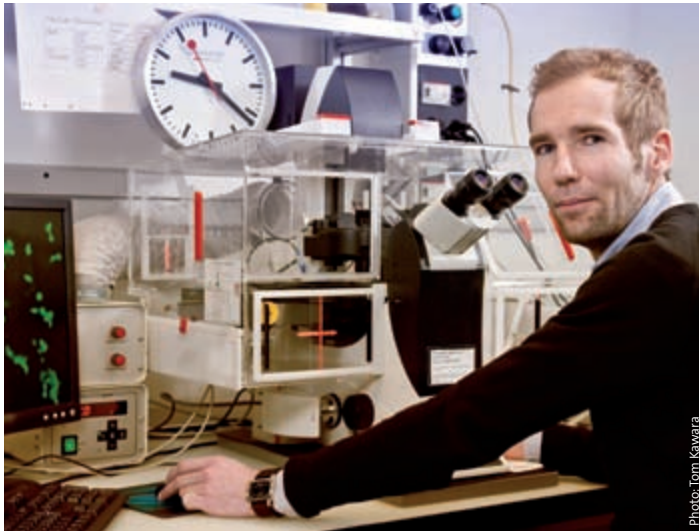


Photo: Tom Kawara

Endurance at the microscope paid off: "Nature" first author Marcel Tigges (31).

A research team at ETH Zurich has artificially created mechanisms modelled on the body clock in mammal cells – a world first. Possible therapies with such a biological dispenser sound futuristic, but promising.

People with irritating jetlag following an overseas flight are suffering from a confused body clock. Shift workers also have to deal with a disturbed rhythm to their life. Our sleep and wake phases are oriented around a biological timekeeper. This body clock follows the daily period of 24 hours and is the timer for biochemical and physiological processes in most organisms.

However, until now it has generally remained a mystery just how this mechanism actually works. For the first time, an interdisciplinary group at ETH Zurich has managed to synthetically create such a self-regulating cycle in mammal cells. The research work was led by Professors Martin Fussenegger and Jörg Stelling from the Department of Biosystems Science and Engineering (D-BSSE) and was recently published in the science journal "Nature" (457, pages 309-312). The first author of the paper is post-doc Marcel Tigges.

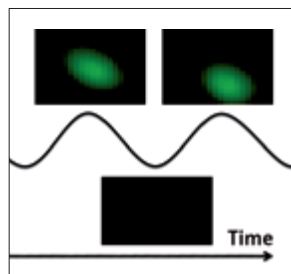
For the study, the scientists used artificial gene control systems, which they combined in a similar way to an electric circuit. This allowed proteins to be rhythmically produced in

the cells. Three genes with different functions were used for this: two mutually regulating genes and one that shows the dynamic processes with a fluorescent protein. The mutually regulating genes interplay with a slight time delay and thus act as the timekeepers of the oscillations. This has created the first mammal oscillator that can be regulated, mimicking the mechanism of a body clock.

Replacing pills or injections?

Synthetic biology allows the oscillator to be further devel-

oped so that it can be useful from a therapeutic perspective. Martin Fussenegger is convinced of this. This would enable complex gene therapy treatments – for example by molecularly automating physiological processes that are repeated several times a day. The artificial body clock could be used to give people insulin doses, replacing the daily injection.



Artificial body clock: made visible by a green fluorescent protein, produced in oscillations (on/off) by a cell.

in the tablet on a genetic basis. The frequency of the oscillator would determine how often the medicine is produced and released into the body (x times a day), the amplitude dictates the dosage (number of pills). "However, we still have a long way to go until we reach the stage where this promising application can be applied", explains Jörg Stelling.

EDITORIAL

Secure knowledge

Dear Reader,



Receiving public recognition requires a great deal of fighting for attention. Even

researchers sometimes lose their common sense and reveal unsecured knowledge to the public. However, this hasty desire for publicity damages science's image. Research loses its credibility and also gives an inaccurate impression of itself. It usually takes several years for knowledge to become incontestable.

I would therefore like to suggest that responsible scientists should be careful when explaining their findings to the community. This restraint does not by any means stem from life in an ivory-tower, but rather from a desire for reliable scientific progress.

R. Eichler

Prof. Dr. Ralph Eichler,
President of ETH Zurich

"QUOTE ... UNQUOTE"

"Being top in the natural sciences will, in future, also mean being top in computer simulations"

Thomas Schulthess, new director at the Swiss National Supercomputing Centre (CSCS)

MOTOR TECHNOLOGY

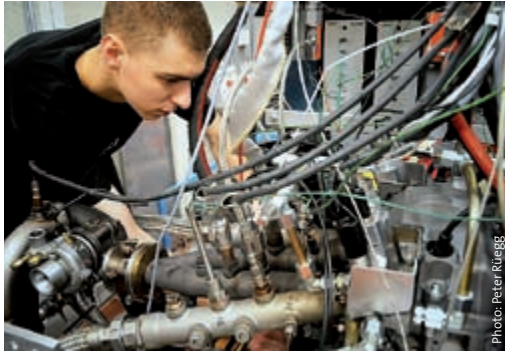


Photo: Peter Rüegg

Economical and cheap: The ETH drive concept of the future.

Pneumatic hybrid

ETH researchers have developed a hybrid petrol engine that stores energy as air pressure instead of in a block of batteries. This invention saves 30 percent fuel compared to an ordinary petrol engine, but costs a lot less than an electric hybrid drive.

A technology which could replace the combustion engine is not on the cards over the next two decades. On this, the experts agree. The way forward is currently via hybrid concepts that remain affordable and still offer all of the advantages of a petrol or diesel motor.

A group led by Lino Guzzella, ETH professor for thermotronics, is working on a promising solution. Their pneumatic hybrid drive connects an air pressure tank to the motor instead of a battery. When required, such as when starting or after changing gear, air flows into the motor and powers the pistons.

The pneumatic hybrid only achieves around 80 percent of the fuel savings of an electronic hybrid, but the price-performance ratio is significantly better. The motor concept has been greeted with great interest in the sector.

www.imrt.ethz.ch/research/engine/phybe

ION BEAM PHYSICS

Ötzi in the ETH labs

What began in 1963 with a particle accelerator for nuclear physics is now a world-leading laboratory for ion beam physics. It specialises in self-developed machines and methods, which can also serve to determine the age of important objects.

The method is defined as Accelerator Mass Spectrometry (AMS) and is used to determine the isotope concentration of long-living radionuclides. Comparative measurements with unstable atom nuclides that decompose radioactively can, for example, be used as a basis for determining the age of organic material.

Famous objects such as the shroud of Turin or the mummified prehistoric man Ötzi have been dated in this way at the ETH Laboratory for Ion Beam Physics. The AMS method is several times more powerful than traditional dating methods, i.e. it is very accurate and sensitive. Its inventors say it can be visualised in terms of detecting the molecules of a sugar cube dissolved in Lake Constance.

Medicines made available more quickly

Radiocarbon dating with carbon isotopes is the most well known application. However, the ETH instruments can also measure other radionuclides, with uses including dating in climate research or geology.

Detecting radioisotopes can also be used as natural trace elements in life sciences. For example, a mass spectrometer was developed and built for the pharmaceutical industry, using ^{14}C as a tracer in the development of new active substances. This allows a reduction in the time taken for the developed medicine to be put into use.

www.ams.ethz.ch

LATEST

Sustainable building

ETH Zurich and Siemens Switzerland (Building Technologies) are stepping up their education and research activities in the area of sustainable building. The involvement with Siemens includes a new professorship and amounts to around 5 million Swiss Francs. The agreement was arranged together with the ETH Zurich Foundation and ETH Transfer.

Call for involvement in discussions

The national government is breaking new ground: ETH Zurich has launched a new web platform at www.sipolog.ethz.ch, which aims to stimulate a broad discussion about the report on security policy by the Swiss Federal Council. SIPOL WEB is operated and moderated by the Centre for Security Studies at ETH Zurich.



Neuroscientists to-be

As part of the BrainFair, 27 school classes visited various institutions at ETH, the university and university hospital of Zurich. The demand was so great that many classes had to be turned away. BrainFair aims to inform the general public about neuroscience.

FINAL WORD

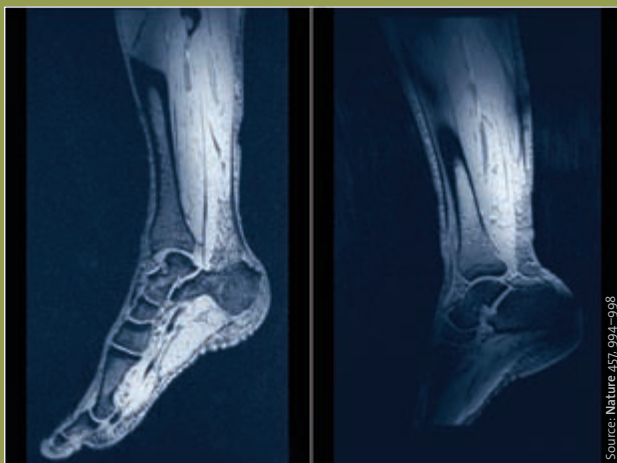
The robotic chair

As if hit by an explosion, it breaks into six individual parts and then carefully puts itself back together again. Young and old are fascinated by the robotic chair. Nothing conveys the innovative power and interdisciplinary teamwork in technology better than this stool, filled with ingenious electronics.

The work was created by a team led by ETH professor Raffaello D'Andrea. It combines art (Max Dean) and design (Matt Donovan) with science and the latest in engineering. You will be amazed!

www.Raffaello.name (video)

UNDER THE SPOTLIGHT: MRI MAKES A TECHNOLOGICAL LEAP FORWARD



Source: Nature 457: 994-998

Tomograms of the body have become a significant part of medicine today. A research team at the Institute for Biomedical Engineering at ETH and the University of Zurich has now considerably advanced the imaging MRI method.

The magnetic resonances in the body are no longer stimulated and displayed through standing waves; instead propagating waves are used. The illumination of the resulting images is considerably improved, and they can be detected from a distance of several metres (left).