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The world's most valuable brain research prize goes to inventors and developers of revolutionary microscopic technique

The world's largest prize for brain research- [The Brain Prize](#) - goes to four brain researchers for the invention, development and application of the revolutionary technique *two-photon microscopy*.

Copenhagen, 9th March 2015: The world's most valuable (€1m) neuroscience prize, [The Brain Prize](#) has been awarded, to four scientists, **Winfried Denk** and **Arthur Konnerth (Germany)**, and **Karel Svoboda** and **David Tank (USA)**, for the invention and development of two-photon microscopy, a transformative tool in brain research.

Two-photon microscopy is one of a handful of techniques which over the last 15 years have dramatically changed the way we study the brain. It combines advanced techniques from physics and biology, to allow scientists to examine the finest structures of the brain, in real time.

Using this revolutionary technology, researchers are now able to examine the function of individual nerve cells with high precision, especially how nerve cells communicate with each other in networks. This is a huge step forward in the understanding of the physical mechanisms of the human brain and in the understanding of how the brain's networks process information. Furthermore, researchers have been able to follow how connections between nerve cells are established in the developing brain.

It has led to identification of signaling pathways that control communication between nerve cells and provide the basis for memory, and it has enabled the study of nerve cell activity in those networks that controls vision, hearing and movement.

Professor Povl Krogsgaard-Larsen, Chair of Grete Lundbeck European Brain Research Foundation, which awards The Brain Prize, said:

"Thanks to these four scientists we're now able to study the normal brain's development and attempt to understand what goes wrong when we're affected by destructive diseases such as Alzheimer's and other types of dementia. More than that, we are able to visualise how adaptive behavioural changes affect the nerve cells of living animals.

Winfried Denk was the driving force behind the invention of two-photon microscopy. With David Tank and Karel Svoboda he used the technique as an innovative tool to visualise activity at the level of the neurons' fundamental signalling units, the "dendritic spines". Arthur Konnerth built on this invention to simultaneously monitor the activity in thousands of synaptic connections in living animals, and Karel Svoboda went on to use two-photon microscopy to map the changes that occur in the brain's network when animals learn new skills.

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Since its invention in 1990, two-photon microscopy has formed the basis of more than 10,000 research papers, not only in brain research but also in other areas of physiology, embryology and tissue engineering

Professor Maiken Nedergaard, of the University of Rochester Medical School, New York, said:

"Traditionally, brain research made use of electrical measurements to study the activity of neurons. Two-photon microscopy has revolutionised the study of the brain, since it is now possible to map the function of the individual parts of a neuron as well as communication between several thousand neurons in live, behaving animals".

About two-photon microscopy

Two-photon microscopy uses an advanced form of fluorescence microscopy. In fluorescence microscopy, cell components are labelled with special molecules, which glow (fluoresce) when illuminated by light of a particular wavelength, usually UV-light. The microscope then picks up the emitted fluorescent light. However, the short wavelength, high energy UV-light tends to spread through, the tissue making more areas fluoresce and making it difficult to focus upon a specific cell or cell part. Furthermore, UV-light cannot penetrate deep into the tissue, and because of its high energy quickly exhausts the fluorescent molecules.

Two-photon microscopy uses pulsed infrared lasers to focus the illumination only on the target area, which is the only area which then emits light. "It's like the difference between looking at a movie in daylight, and looking at a movie in a dark hall: if you take away the unwanted light you can see what you want to see much better", said Maiken Nedergaard.

The two-photon principle allows the use of long wavelength (low energy) infrared light. Under normal circumstances, one photon of infrared light is not enough to elicit fluorescence. However, the pulsed laser can deliver a large amount of light to a specific point. Intermittently two photons will hit a fluorescent molecule, which is sufficient to make it glow. The infrared light does not exhaust the fluorescent molecules, as happens in conventional fluorescence microscopy. Furthermore, infrared light can go much deeper down into the tissue: this gives the technique its main advantage, for the first time we can see real changes inside a living, active brain, even down to hundreds of micrometres below the brain surface (a human hair is around 90 micrometres thick).

The four researchers will share the one million Euro prize, which will be presented at a ceremony on 7 May in Copenhagen by His Royal Highness Crown Prince Frederik of Denmark.

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Notes for editors

For more information, please contact Brain Prize Press Officer, Tom Parkhill, tom@parkhill.it telephone +39 349 238 8191

More information is available on The Brain Prize website, <http://www.thebrainprize.org/>

This is a password-protected site, and will not be in the public domain until the time of the embargo. The username: tbp and the password: tbp2015 is only available to journalists. Biographies and photographs of the winners (http://www.thebrainprize.org/flx/press_lounge/)

- Images using two-photon microscopy
- Video material made using two-photon microscopy

CONTACT INFORMATION

Contact details, and biographies of individual prizewinners, can be found below:

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Background Information

- The one million euro Brain Prize is awarded by the independent, charitable Grete Lundbeck European Brain Research Foundation, The Brain Prize.
- In 2015, the Prize will be awarded for the fifth consecutive year. This year, it will be awarded for “*the invention, refinement and use of two-photon microscopy to provide detailed, dynamic images of activity*”

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in individual nerve cells, dendrites and synapses, thereby transforming the study of development, plasticity and functional circuitry of the brain”.

- The Brain Prize is a personal prize, awarded to one or more scientists who have achieved distinction through outstanding contributions to European brain research. Brain prize winners will contribute to a series of outreach activities in Denmark during 2015.
- The Prize will be presented by His Royal Highness the Crown Prince of Denmark on 7 May, 2015, in Copenhagen.

More information can be found on The Brain Prize website, <http://www.thebrainprize.org/>