Leibniz ipht
LEIBNIZ-INSTITUT für PHOTONISCHE TECHNOLOGIEN

STANDORT LOCATION
Albert-Einstein-Str. 9
07745 Jena · Germany

POSTANSCHRIFT POSTAL ADDRESS
PF 100 239
07702 Jena · Germany

PRESSE- UND ÖFFENTLICHKEITSARBEIT
PUBLIC RELATION
Daniel Siegesmund

TELEFON PHONE
0049 3641 206-024

TELEFAX FAX
0049 3641 206-044

E-MAIL E-MAIL
daniel.siegesmund@leibniz-ipht.de

WEB WEB
www.leibniz-ipht.de

Date: 02.01.2018

Embargo: none

Observing brain cells at work

Tomáš Čižmár's research work concerns new methods of controlling light propagation in optical fibers. The aim of his research work is to produce miniaturized fiber-optic probes which would enable him to observe individual brain cells at "work" in a living organism. Through a better understanding of so far rather unexplored fundamental biological processes, researchers hope to find answers to complex questions. Such as how memories are anchored in our brain and how we recall them again. The technology could be useful to better understand the onset of Alzheimer's disease or other severe neurological disorders.

From January 2, 2018, Tomáš Čižmár is appointed Professor of Wave Guide Optics and Fiber Optics at the Faculty of Physics and Astronomy at Friedrich Schiller University Jena and will be Head of the Department of Fiber Optics at the Leibniz Institute of Photonic Technology Jena (Leibniz IPHT). His research areas include topics such as the optical manipulation of minuscule particles, the investigation of light propagation in optical fibers and their application in hair-thin endoscopic fiber probes for biomedical imaging.

In order to obtain high-resolution images from regions of the body difficult to reach, such as the brain, without causing extensive damage to it, hair-thin endoscopy probes are required. Conventional fiber-based endoscopes would be too large for such interventions. They are mostly comprised of a bundle of several optical fibers, in which each fiber transmits one pixel of the image. A holographic method developed by Tomáš Čižmár now allows transmission of high resolution images through a single optical fiber that is as thin as a tenth of a millimetre. "Until recently, complex and hardly predictable light propagation in such multi-mode fibers prevented their use in microscopy. The imagery received from these fibers is entirely scrambled and chaotic. However, by means of digital holography and computer algorithms, we succeeded in restoring the distorted images. High resolution microscopy with extremely thin fibers opens up a window to study processes in previously inaccessible regions in living organisms – possibly also in a human someday," Tomáš Čižmár opines about the future of the technology.

For his research project LIFEGATE, Tomáš Čižmár received the well-recognized Consolidator Grant funded by the European Research Council (ERC) – a distinction for excellent scientist. The ERC funds the project of the 38 year old scientist at Leibniz-IPHT

for the duration of five years. Tomáš Čižmár intends to first study more precisely the processes of light propagation in multi-mode fibers. To eventually use the technology also in the micro endoscopy, the fibers must be above all flexible. That is indeed a challenge, because as the fibers bend, the transmitted image becomes distorted differently. The researcher is hoping to find a solution to this problem by understanding the propagation of light in the fiber more accurately. As well, Čižmár plans to increase the relatively slow speed of the transmission by employing faster graphics processors and better data processing algorithms. “At the IPHT, I can make use of the unique technological infrastructure for my fundamental research in the field of fiber optics and fiber technology. Moreover, the holographic micro-endoscopy can be combined with the imaging techniques established here and, thus, extend the range of light-based technologies in medicine and biology“, the Czech-born scientist explains his decision to come to Jena. While working at the Leibniz-IPHT, he is simultaneously conducting research together with colleagues at the Institute of Scientific Instruments in Brno/Czech Republic on the integration of fibers in micro-endoscopy probes and their experimental application.

About Tomáš Čižmár

From 2003 to 2007, the physicist worked in the group led by Prof. Pavel Zemánek at the Institute of Scientific Instruments at the Czech Academy of Sciences and the Masaryk University in Brno, where he received his doctorate in the field of wave and particle optics in 2006. Thereafter, Čižmár continued to pursue his postdoctoral research work in the group headed by Prof. Kishan Dholakia at the University of St Andrews, Scotland in a number of projects on the subject of optical manipulation and biomedical photonics. Funded by an academic fellowship, in 2010 he changed over from the School of Physics & Astronomy to the School of Medicine in order to establish innovative concepts there for holographic endoscopy which is a new area of complex photonics. Prior to moving over to Jena, Čižmár was a reader (associated professor) at the University of Dundee. In his research group named “Complex Photonics” at Dundee, he investigated new methods of optical manipulation, photonics in chaotic systems and light conduction processes in optical fibers.