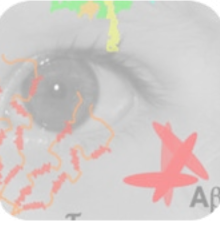
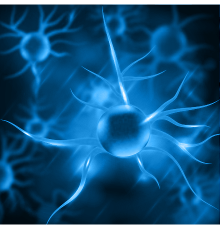
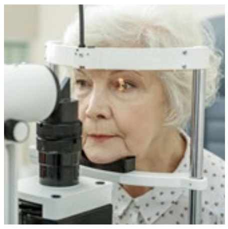


Multimodal Optical Diagnosis of Ocular and Neurodegenerative Disease





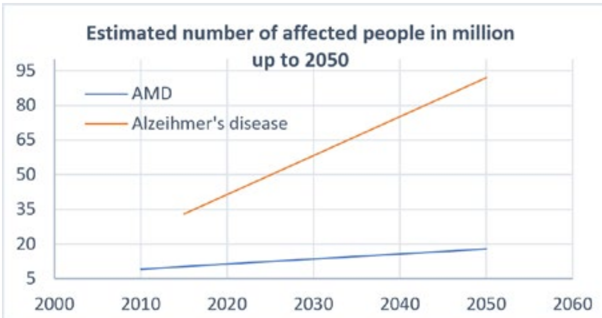
PHOTONICS[21]
PHOTONICS PUBLIC PRIVATE PARTNERSHIP
Research and Innovative Programme

Keywords

Optical Coherence Tomography, Raman Spectroscopy, Fluorescence, Neurodegenerative Diseases, Vision, Optical Diagnosis, *In Vivo, ,* Morpho-chemical characterization, Clinical study

A NEW GENERATION OF MULTIMODAL SYSTEM

The increasing life expectancy of citizens is creating a dramatic growth of the number of people suffering from age-related degenerative diseases and associated healthcare costs. The MOON Project (Multimodal Optical Diagnostics for Ocular and Neurodegenerative Disease) addresses this societal challenge by applying photonics to diagnose age-related diseases of the eye and central nervous system diseases such as Alzheimer's diseases.



THE PROJECT

During this project, an innovative diagnostic platform is developed, combining the strength of complementary modalities such as fundus imaging, optical coherence tomography, and Raman spectroscopy.
The eye serves as window to the brain, as the retinal neural tissue may be similarly and maybe even earlier affected by major neurodegenerative diseases as the brain tissue itself. First signs of disease may therefore be diagnosed at an early stage, even before symptoms appear and when treatment is more likely to be possible. The treatment would have a huge societal impact on the quality of life of patients and their caretakers as well as on the national healthcare systems themselves.

Improved retinal disease diagnostics

In-depth molecular specific diagnostics of neuro-degenerative disease

THE APPLICATIONS

A new method is developed to enable a reliable and fast detection of aged-related macular degeneration in the future. The optical method can provide detailed information on the condition of the retinal tissue. With this eye scan, physicians shall be able to detect aggressive forms of AMD sooner and even detect neurodegenerative diseases such as Alzheimer's.

THE ACHIEVEMENT

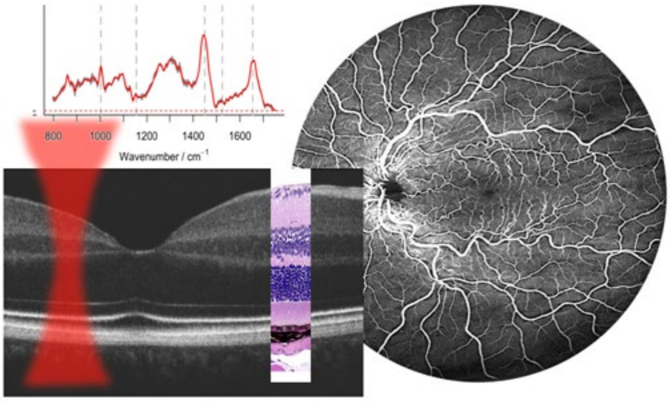


Figure 1. Full montage showing the technology of MOON bridging structure, molecular information, and function.

Raman confocal imaging of in-vitro human retina sample with a high spatial and spectral resolution was performed, revealing details about the retina's molecular composition, i.e. lipids, proteins, nucleic acids, as well as strongly localized clusters of macromolecules.

Figure 1 represents the full montage describing the technology of MOON bridging structure, molecular information, and function. The rectangular image shows an OCT scan of the human retina. The inlay corresponding to the histology to the retina means that OCT is aiming at the retinal structure at microscopic level. The red cone indicates that the retina is scanned with light allowing to get a Raman spectrum that highlights chemical information. The round image is an OCT angiography, that was obtained non-invasively over an unprecedented wide field of view, without the need of injecting dyes.

For the first time non-resonant Raman spectroscopy was used to study ex-vivo human retina samples complying with the international laser safety regulations (Fig1). Encouraged by those results the approval for in-vivo use of the multimodal MOON platform by the national authorities according to the European Medical Device Regulations has been obtained. A multimodal platform combining Raman spectroscopy with Optical Coherence Tomography (OCT) significantly extended exploratory ophthalmology techniques existing currently. Fast OCT imaging is used to identify regions of interest for in-depth molecular characterization using Raman spectroscopy. Figure 2 shows the MOON2 system in action.

Two clinical studies are currently performed with clinical partners at Medical University of Vienna targeting age-related macula degeneration and Alzheimer's, generating first ever human in-vivo Raman spectroscopy data. Those data are now analyzed and prepared for publication. The multimodal platform creates great potential for morpho-chemical characterization of human retina, allowing for determination of novel biomarkers for early diagnostics of age-related ophthalmic and neurodegenerative disease.

Figure 2. How to improve the early diagnostics of ophtalmic diseases?
«MOON2 system in action»

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