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**Team from Rostock and Hanover aims to detect melanoma skin cancer with optical scanner**

*Leibniz University Hannover and Rostock University Medical Center receive funding for the development of non-invasive optical melanoma diagnostics.*

Incidence rates for black skin cancer, also known as cutaneous melanoma, continue to increase on global scale. In Germany alone, around 25,000 men and women are currently diagnosed with this most dangerous type of skin cancer, also with rising trend. Melanoma are hard to treat when diagnosed at a late stage. Therefore, early diagnosis and complete surgical excision are essential for improving of the prognosis of patients in general. Furthermore, with progression of the disease, the average treatment costs per patient increase significantly from a few thousand Euros (stage I) to several hundred thousand Euros (stage III/IV). To date, a precise diagnosis is only possible after surgical removal of the suspicious lesion and subsequent histopathology. In case the lesion is malignant, any remaining tumour tissue needs to be removed in a second excision with a safety margin, and also adjacent lymph nodes.

To enable non-invasive, fast and ultimately also cheaper diagnosis, a team of physicists from the Leibniz University Hanover is working together with physicians from the University Dermatology Clinic Rostock. The team at the Hanover Centre for Optical Technologies (HOT) lead by Prof. Dr. Bernhard Roth is developing the optical system for the non-invasive measurement, the so-called optical biopsy. The collaborating team of Prof. Dr. Steffen Emmert, Director of the Clinic and Polyclinic for Dermatology and Venereology at the University Medical Center Rostock carries out the diagnostic validation and testing in the clinical practice. During the past years, the two scientists have already worked together on this topic and demonstrated the feasibility of their approach.

The proposed "skin scanner" is intended to reliably detect both the benign or malignant nature of a lesion and the penetration depth. For this purpose, the physicists combine three optical technologies: Optical Coherence Tomography is used to provide information about thinner skin lesions. It is comparable to ultrasound, except that light waves are employed instead of sound. The optoacoustic modality relies on laser pulses to generate sound waves in the tissue which analyze the thicker lesions. Finally, Raman spectroscopy which exploits the scattering of light in the tissue is used to obtain a "fingerprint" of each lesion revealing whether it is malignant or benign. "At present, no other technology can provide non-invasive diagnostics. Our approach would, therefore, represent a real innovation in the field," says Roth, who is also developing new optical measurement techniques for broad applications, e.g. in medicine or environmental analysis, within the Cluster of Excellence PhoenixD of Leibniz University Hannover.

The method offers several advantages: In future, the "optical biopsy" could replace the scalpel in skin cancer diagnostics. Suspicious lesions will be scanned non-invasively potentially replacing surgical excision and histopathology. Furthermore, waiting times for doctors and patients will be reduced, as they will know immediately after the scan whether the lesion is malignant or not. The new procedure could also save costs for unnecessary interventions, as currently 86 to 95 per cent of the lesions turn out to be benign.

The non-invasive system will also incorporate concepts from artificial intelligence so that the diagnostic accuracy can be improved continuously. "It is our goal that future examinations will no longer have to be performed exclusively by a physician, but also by non-medical personnel," says Anatoly Fedorov Kukk, research associate in the project. "If doctors could detect only ten per cent of melanoma at an earlier stage, health systems could save costs of up to several million euros per year," says Emmert. "The new device could also be used for other skin diseases and lead to completely new approaches in therapy monitoring", he adds.

The German Research Foundation (DFG) is funding the research with around 1.1 million euros and in total three staff positions in Hannover and Rostock for the duration of three years.

**The PhoenixD Cluster of Excellence**

Between 2019 and 2025, the Cluster of Excellence PhoenixD led by Leibniz University Hannover will receive approximately 52 million euros of funding from the federal government and the State of Lower Saxony via the German Research Foundation (DFG). The cluster is a collaboration of TU Braunschweig, Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Physikalisch-Technische Bundesanstalt and Laser Zentrum Hannover e.V. Within the scope of the cluster, more than 100 scientists from the fields of physics, mechanical engineering, electrical engineering, chemistry, computer science and mathematics conduct interdisciplinary research. The Cluster explores the possibilities offered by digitalisation for novel optical systems as well as their production and application.

**Note to editors:**For further information, please contact Prof. Dr. Bernhard Roth, Managing Director of the HOT – Hannover Centre of Optical Technologies and Head of the Task Group F1 - Precision Metrology in the Cluster of Excellence PhoenixD, Phone +49 511 762 17907, Email: [bernhard.roth@hot.uni-hannover.de](mailto:bernhard.roth@hot.uni-hannover.de)

Prof. Dr. Steffen Emmert, Director of the Clinic and Polyclinic for Dermatology and Venereology, Rostock University Medical Center, Phone +49 381 494 9700, Email: Steffen.Emmert@med.uni-rostock.de

Ansprechpartnerin für die Presse:

Universitätsmedizin Rostock, Susanne Schimke, Tel.: +49 (0) 381 494 50 90, susanne.schimke@med.uni-rostock.de