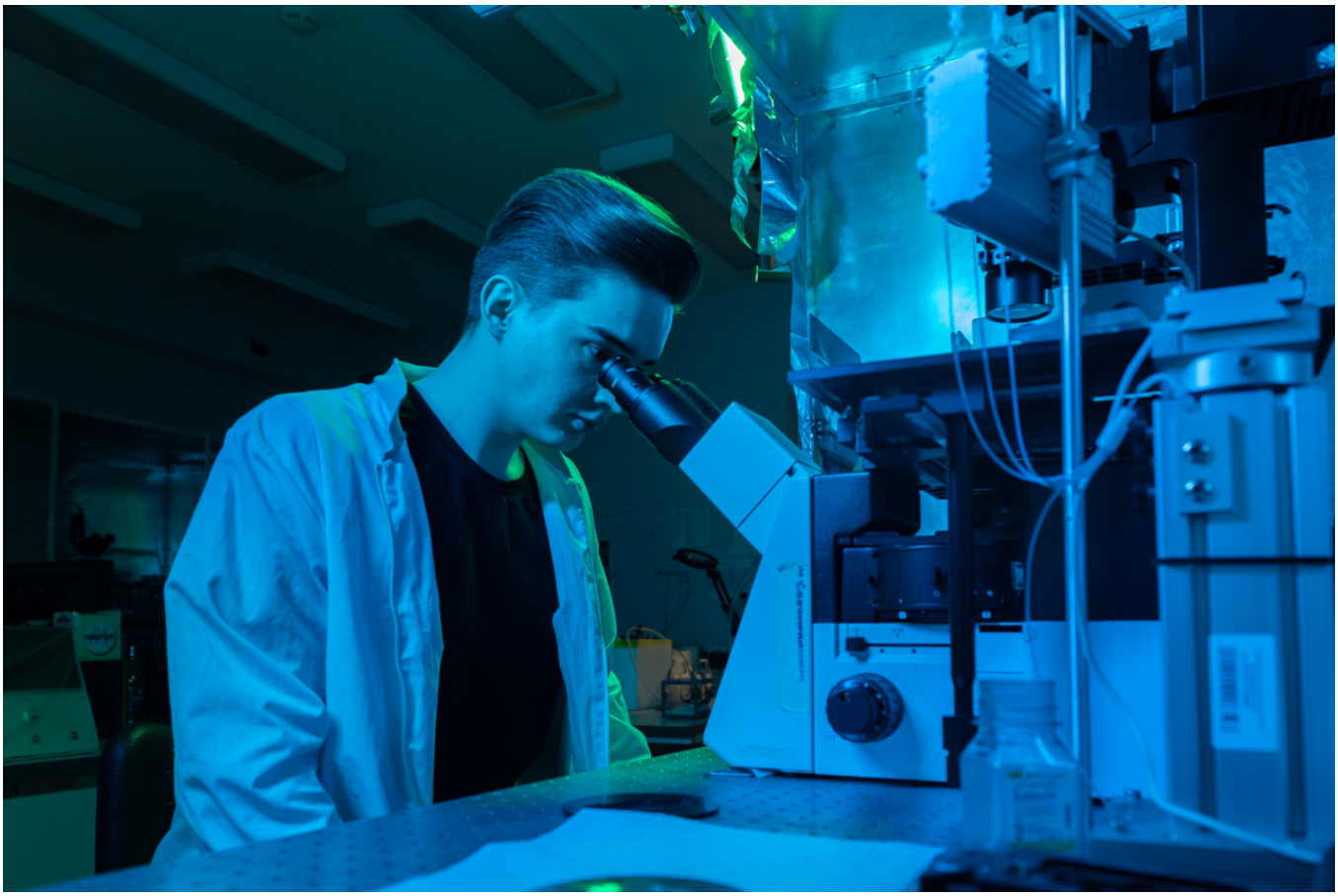
SPbPU scientists develop breakthrough method for diagnosing depression

According to the World Health Organization, about 280 million people in the world suffer from depression. This mental disorder has a strong impact on health and significantly reduces the quality of life. The world is searching for a way to instrumentally diagnose depression, as well as other socially significant neuropsychiatric disorders. The research group of the Graduate School of Biomedical Systems and Technologies of SPbPU conducted a study, during which they found statistically significant differences in the inter-channel interactions of various brain regions in healthy subjects and depressed patients. In the future, this will make it possible to develop an objective method of diagnosing mental illnesses. The results are published in the scientific journal Biophysics.

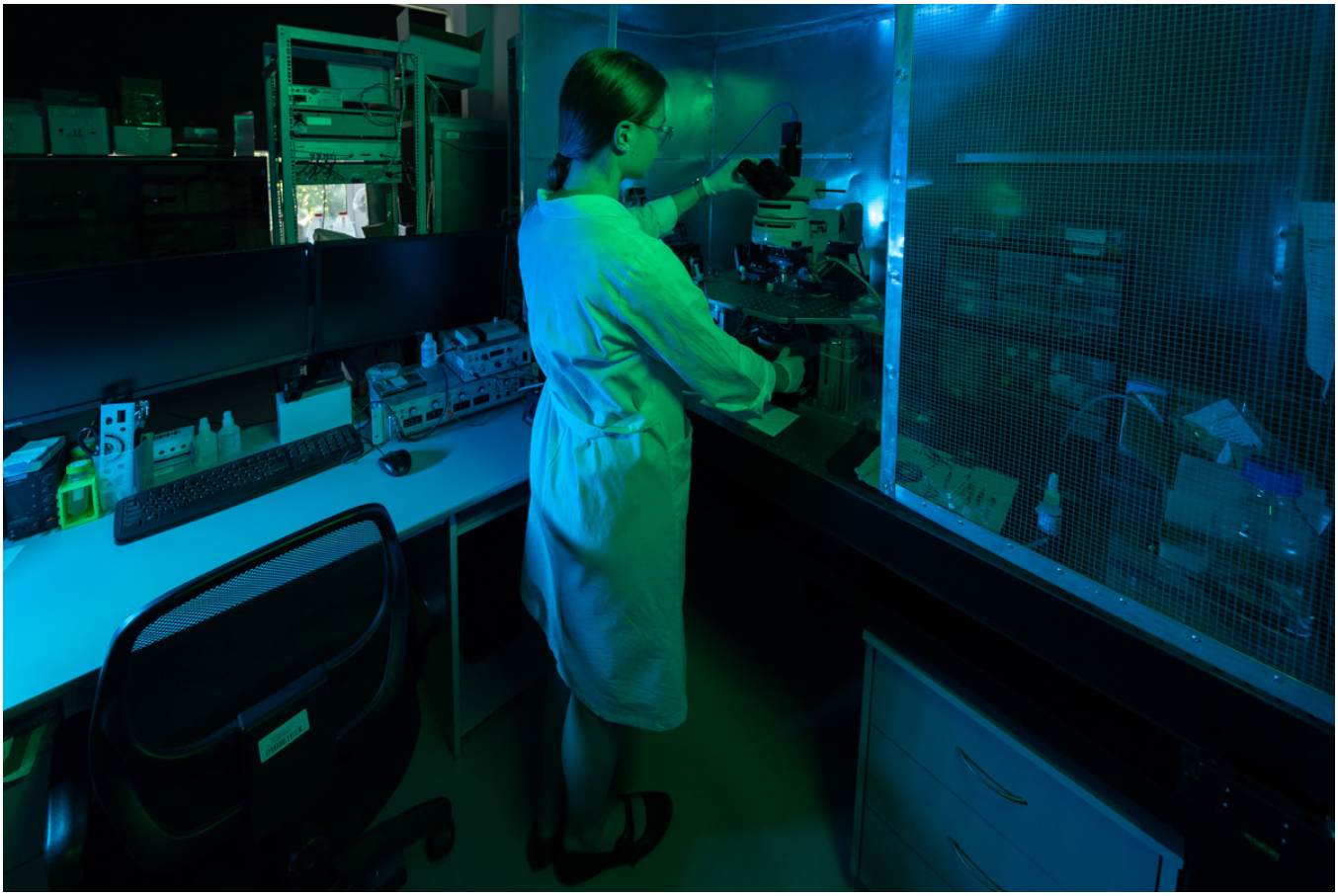


According to physicians, depression can be caused by one or several interrelated psychological, social, neurochemical and hereditary factors. In the world scientific literature repeatedly published data on morphological changes in certain parts of the brain in patients with not only depression, but also other psychiatric and neurological disorders.

Electroencephalography (EEG) allows us to analyze the functional state of the

brain in real time, but the question of interpretation of the obtained data remains relevant. Despite a large number of studies, including those devoted to the analysis of various tomographic data, no strict binding of certain changes in the brain to a particular disease has been found to date. Polytechnic scientists have recorded statistically significant differences in inter-channel interactions (according to EEG data) of various brain regions in healthy subjects and depressed patients.

Certain morphological changes of certain brain regions can be observed in patients not only with depression, but also with other psychiatric and neurological disorders. Unfortunately, if certain changes have occurred, it is almost impossible to return to the initial state, but the process can be suspended. For this reason, it is very important to diagnose the disease at an early stage, and this requires an objective diagnostic parameter, said Olga Vlasova, doctor of physical and mathematical sciences, director of the Graduate School of Biomedical Systems and Technologies of SPbPU.



The scientists analyzed the EEG data of 21 healthy people aged 18 to 63 years, as well as 9 patients aged 23 to 70 years with depression (the official diagnosis was made by a psychiatrist). The subjects underwent electroencephalography at the V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology. The resulting data were mathematically processed and quantitative parameters were obtained, which can be considered as objective characteristics of a particular disease. Such parameters can be found not only for depressive

disorders, but also for other diseases, which makes the approach developed in Polytech universal.

The method of correlation relations allows us to calculate certain quantitative parameters. Studies have proven that these parameters differ in healthy subjects and in depressed patients. Previously, a predominantly linear approach (linear mathematical function) was used to study inter-channel interactions in the human brain. But this approach may not always correctly interpret the ultra-complex bioelectrical processes of the brain or miss some interaction that can be detected only with a nonlinear approach (nonlinear mathematical dependence). The method of correlation relations is able to objectively characterize the levels of connection between different brain areas under arbitrary models: linear (linear mathematical function) or nonlinear (nonlinear mathematical function). In addition, this method allows you to identify the directionality of the studied connection, — said one of the authors of the study Maxim Sobolev (at the time of the work — a graduate student of Polytechnic University — ed.).

As a result of the study, scientists instrumentally found a number of changes in the brain of patients with depression, different from the results of people from the control group. For example, in depressed patients they found a decrease in interhemispheric occipital connections in the delta frequency range, an increase in right intrahemispheric connections between parietal and temporal regions in the theta frequency range, a decrease in frontal interhemispheric relationships in the alpha frequency range, and other changes.

We plan to further validate the results obtained. More extensive statistical processing is required, i.e., an increase in the data sample, and comparative analysis with already available methods of quantitative evaluation of EEG data (in particular, those using a linear approach). Of course, it is necessary to demonstrate the universality of the proposed approach on other neurological and psychiatric diseases, said Olga Vlasova, Doctor of Physical and Mathematical Sciences, Director of the Graduate School of Biomedical Systems and Technologies at SPbPU.

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