University	Peter the Great St. Petersburg Polytechnic University
Level of English proficiency	Intermediate (B1)
Educational program and field of the educational program for which the applicant will be accepted	PHYSICAL SCIENCES & TECHNOLOGY 1.5.2. Biophysics BIOLOGY & BIOTECHNOLOGY 1.5.3. Molecular biology
List of research projects of the potential supervisor (participation/leadership)	RSF grant No. 20-65-46004 "The role of astroglia in the regulation of the activity of neural networks of transgenic models of Alzheimer's disease according to optogenetics, epigenetics, electrophysiology and behavior" Federal Target Program Grant No. 14.B37.21.0121 "Biophysical study of the role of calcium signaling in polyglutamine neurodegenerative diseases" Megagrant No. 11.G34.31.0056 "The role of calcium signaling in neurodegenerative diseases" State Assignment No. 17.1360.2014/K "Investigation of the role of calcium signaling in the pathogenesis of neurodegenerative diseases and the search for therapeutic agents"
List of the topics offered for the prospective scientific research	The role of astrocyte activation in synaptic transmission in an Alzheimer's disease model Study of the molecular mechanisms of impaired neuronal activation and methods of recovery
 Research supervisor: Olga L. Vlasova,	*Biological sciences* 1.06. Biochemistry & molecular biology
	Supervisor's research interests To date, AD is one of the most common and incurable neurodegenerative diseases (NDD), which affects the processes of memory formation, its subsequent storage and leads to a progressive decrease in cognitive abilities. A significant part of the world's developments to find a treatment for AD was aimed at reducing the production of beta-amyloid, preventing its aggregation, or finding ways to remove its toxic aggregates from the brain, but this approach has demonstrated its ineffectiveness at the stage of clinical trials. One of the new strategies being developed at SPbPU Laboratory of Molecular Neurodegeneration (laboratory Head, the winner of the 2011 mega-grant competition Iliya B. Bezprozvanny) has become the strategy of searching for

DSc. in Physics and Mathematics (biophysics). (The degree was awarded based on the decision of the Dissertation Council of Peter the Great St. Petersburg Polytechnic University)	therapeutic agents capable of restoring memory by restoring the density of mushroom-shaped dendritic spines (lost in the process of disruption of intracellular calcium signaling in neurons) that form stable synaptic contacts in the hippocampus. At the same time, in recent years, more and more literature data testifies in favor of the significant role of not only neural, but also neuroglial networks in the development and maintenance of human cognitive functions, including memory. Astrocytes are closely associated with the pathogenesis and pathological processes of neurodegenerative diseases. Therefore, another interesting new strategy may be to determine the role of astroglia as a potential therapeutic target. Optogenetics has become increasingly used to identify the function of astrocytes in physiology and pathology. Optogenetic manipulations with astrocytes can be an effective approach both to studying the pathology itself and for the therapeutic purposes of NDD. Two types of optogenetic activation of astrocytes associated with the regulation of Ca2+ ions are known (the use of channel and metabotropic opsins). However, the role of astroglia in the restoration of cognitive functions using optogenetics remains not yet fully understood. A small number of works have been published which deal with hippocampal astrocytes activation. Of interest is the optogenetic effect on hippocampal astroglial cells using two types of non-contact optical regulation: changes in the membrane potential or activation of metabotropic G-protein opsin receptors. At the same time, in the first case, the main mechanism of astroglia activation under the influence of light on photosensitive channelorhodopsins is the induction of calcium entry into the cytosol and an increase in the level of free calcium in the cell, which stimulates the release of gliotransmitters and their effect on the neuron, and in the second case, the release of calcium from intracellular depots under physiological stimulation of Gq-coupled receptors. At the same time, close functional relationships between the mechanisms of calcium entry and release from intracellular depots into the cytosol allow one to count on the possibility of achieving calcium signaling close to physiological parameters in optogenetically stimulated astrocytes, and parallel control of changes in the electrophysiological parameters of neurons, epigenetic markers of AD, and behavioral features in 5xFAD line transgenic mice with early manifestation of the disease makes it possible to understand the mechanisms of neurodegenerative memory disorders and creates conditions for their regulation.
	Research highlights Development of new approaches to the study of disorders that occur in Alzheimer's disease, search for ways to restore lost functions, search for molecular targets, study of molecular mechanisms of neurodegeneration and neuroprotection.

	Supervisor's specific requirements: Master's degree (or equivalent) in the field of biophysics, biochemistry, chemistry, physics, molecular biology, physiology and related fields. A scholarship or grant for studying and internships is a significant advantage over competitors. Highly motivated specialists who are ready to study, work and determinately solve scientific tasks in a team and independently. Willingness to work with animals (mice). Knowledge of the basics of the Russian language is welcome. In case of an absence of any Russian language skills, the willingness to learn Russian.
	Supervisor's main publications 1. Matveev, M.V., Erofeev, A.I., Pyatishev, E.N., (...), Bezprozvanny, I.B., Vlasova, O.L. An Optoelectronic Neurostimulation System with Adaptive Feedback//Neuroscience and Behavioral Physiology. 2019. 49(2), P. 216-221. 2. Erofeev, A.I., Zakharova, O.A., Terekhin, S.G., (...), Bezprozvanny, I.B., Vlasova, O.L. An Optogenetic Study of the Electrophysiological Properties of Hippocampal Neurons in PS1-M146V Transgenic Mice (a model of Alzheimer's disease)//Neuroscience and Behavioral Physiology.2019. 49(2), P. 199-207. 3. Erofeev, A., Gerasimov, E., Lavrova, A., (...), Bezprozvanny, I., Vlasova, O.L. Light stimulation parameters determine neuron dynamic characteristics// Applied Sciences (Switzerland). 2019. 9(18), 3673. Q1. 4.E.I. Pchitskaya, I.S. Krylov, O.L. Vlasova, M.V. Bolsunovskaya, I.B. Bezprozvanny. ANALYSIS OF DENDRITIC SPINES MORPHOLOGY: FROM CLASSICAL DIVISION TO TYPES TOWARD ALTERNATIVE APPROACHES\ St. Petersburg State Polytechnical University Journal. Physics and Mathematics 12 (2) 2019. P.86-97. DOI: 9.18721/JPM.12207. 5.Zhukov, I.S., Kubarskaya, L.G, Tissen, I.Y., Kozlova, A.A., Dagayev, S.G., Kashuro, V.A., Vlasova, O.L., Sinitca, E.L., Karpova, I.V., Gainetdinov, R.R. Minimal Age-Related Alterations in Behavioral and Hematological Parameters in Trace Amine-Associated Receptor 1 (TAAR1) Knockout Mice//Cellular and Molecular Neurobiology. 2019. P. 1–10. Q1.
	Results of intellectual activity Since 2013 under the supervision of Olga Vlasova the following results have been achieved: members of the research group have obtained new data on the effect of optogenetic activation on synaptic transmission in a cortico-striatal culture of neurons from wild mice and transgenic YAK 128 mice modeling Huntington's disease; the influence of optogenetic activation on the morphology of dendritic spines has been measured and assessed; the effect of the duration, frequency, and intensity of light exposure on the activity of hippocampal neurons in vitro with exogenous expression of ChR2 photosensitive channels has been studied; an optogenetic comparison of the electrophysiological activity of

	hippocampal neurons in normal and pathological conditions has been carried out (transgenic mice line PS1-M146V - a model of Alzheimer's disease); The outcomes of the work carried out are as follows: It has been shown that both cortex neurons and hippocampal neurons of model animals have increased electrophysiological activity with respect to wild-type cells at the early stages of culture maturation or at the initial stages of light stimulation. At the same time, over time, the number of spines, the number of generated action potentials (AP), and in the case of hippocampal neurons, the amplitude of AP, significantly decrease, i.e. with more active electrophysiological behavior in the early stages, experimental cells, unlike wild-type neurons, do not maintain its constancy over time; the necessary and sufficient parameters of light stimulation were selected in experiments with biofeedback in vitro; the optimal interval of the duration of the light pulse is determined - 10-30 ms, at which the amplitude of the response current is maximum. It is shown that the dependence of the membrane current amplitude on the light intensity