Institute of Zoology and Biomedical Research

**Topic:** Control of the activity of midbrain dopaminergic neurons by the nucleus incertus of the rat - anatomy, physiology and function.

**Supervisor:** Dr hab. Tomasz Błasiak (Department of Neurophysiology and Chronobiology)

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**Background information:**At the base of numerous psychiatric and neurological diseases, such as depression, schizophrenia, Parkinson's disease and addiction, is the incorrect functioning of the dopamine system of our brains. These disorders are most likely due to defects in the functioning of the brain structures innervating and controlling the activity of our dopaminergic neurons. In particular, the role of the dopamine system seems to be crucial in the formation of pathological reactions of humans and animals to stress and strong, unpleasant stimuli. Neurobiological mechanisms that mediate the response of dopaminergic neurons to stress are still not well understood.The project will describe a new, hitherto unknown source of innervation controlling the activity of dopaminergic neurons, located in the brainstem of the mammalian brain - precisely in the nucleus called the nucleus incertus. During research conducted on laboratory rats, the anatomy of this neuronal connection will be described and its effect on the electrical activity of dopamine cells will be determined. Thanks to optogenetics, a modern research technique that allows the use of light to control the activity of neurons, it will be checked how the behaviour of animals will change when a newly discovered neuronal tract is activated or deactivated.

**The main question to be addressed in the project:**The scientific goal of the proposed project is to reveal the neuroanatomy, neurophysiology and function of the innervation of mammalian midbrain dopaminergic system by the nucleus incertus of the tegmentum (NI, nucleus incertus). Results obtained in the course of realisation of the project will confirm or deny the hypothesis that the nucleus incertus of the tegmentum is an important centre for the control of the activity of mammalian midbrain dopaminergic system. In particular it will be determined how the level and pattern of action potential firing by the dopaminergic neurons located in the ventral tegmental area (VTA) and substantia nigra pars compacta (SNc) and related changes in the behaviour of the animal depend on the level and mode of firing of NI neurons.

**Information on the methods/description of work:**Experiments planned in the project will be carried out on laboratory rats, using electrophysiological, optogenetic, anatomical and behavioural techniques. The experiments will be carried out in the laboratories of the Department of Neurophysiology and Chronobiology at the Institute of Zoology and Biomedical Research at the Jagiellonian University.

**Special requirements from the student:**  Candidates with prior experience in at least one of research techniques listed below are encouraged to apply:

* extracellular recordings *in vivo* (rodents),
* optogenetic control of neuronal activity,
* behavioural testing of rodents.

**References:**Wise, R.A. (2004) Dopamine, learning and motivation. Nat. Rev. Neurosci., 5, 483–494; Ryan, P.J., Ma, S., Olucha-Bordonau, F.E., Gundlach, A.L. (2011) Nucleus incertus-an emerging modulatory role in arousal, stress and memory. NeurosciBiobehav Rev. 35(6):1326-41.