Abstract – MSc thesis

Neurological research has an essential importance in the description of the function of the nerve system. There are dynamic neuronal activity changes in the living organism that can be observed and examined during in vivo measurements. For this, one of the most common model animals to laboratory practice is the mouse, because of its fast reproduction and economical fact.

We focused on the examination of the activity of different cell types of the primer visual cortex, which cells have different shapes and differ in functions. They can connect each other and create disinhibitory circuits and through these connections, the individual cells of that circuit can influence the activity of other cells of that circuit and cause a special activity pattern in the cortex. These patterns can be related to associative memory and the representation of the brain predictive model, where the manifestation is on the pyramidal cells.

The vasoactive intestinal polypeptide (VIP) expressive GABAergic inhibitory neuron is the cell type in our disinhibitory circuit, that in active state can inhibit other inhibitory interneurons (SOM, PV) in the system, that has a direct connection to them, and which have directly connected principal neurons. That VIP activity results in the disinhibition of these principal neurons.

We examined these neuronal activities by 2-photon-microscopy applying microbial opsin targeted photostimulation. Through that photo manipulation of the GABAergic interneurons, we activated and inhibited the action potential in targeted cortical neurons resulting in changes in the expanded activity pattern.

We observed, that after photostimulation we could achieve changes in activity level in our opsin targeted neurons and in other cell types that maintain connections with them. These effects had also been measured during behavioral tasks. After our experiments, we can say, that the impact of photostimuli can make changes in the activity pattern in opsin expressing interneurons and also in other types of cells than maintain synaptic connections with them. We examined that phenomenon during the execution of behavioral tasks. According to our dates, it is sure, that there is a connection between the functionality of the disinhibitory circuit, the properties of the surprise caused special activity pattern and, the changes in that pattern with photomanipulation.