In the course of our investigation we aim to determine how spinal polarization evoked by trans-spinal direct current stimulation (tsDCS) modifies motoneuron synaptic excitation and disease progression in SOD1 G93A mouse model of amyotrophic lateral sclerosis.

ALS is a devastating neurodegenerative disease affecting more than 220.000 people across the globe in 2015 and estimated to reach over 370.000 in 2040. Over the decades many famous people were diagnosed with ALS including: Lou Gehrig – a US baseball player, Stephen Hawking – internationally renowned physicist or Donald George Revie – a UK professional football player. Despite years of intensive study there is still no cure for ALS, and the only FDA approved drug Riluzole increases the patient's lifespan by approximately 2 – 3 months with two to five years of average survival time after the diagnosis.

Recent studies indicate that a decrease of synaptic excitation of motoneurons is one of the key players in motoneuron degeneration in ALS. Therefore, improving this excitatory input might have positive impact on disease progression. We plan to achieve this goal with the use of novel neuromodulatory technique of trans-spinal direct current stimulation (tsDCS). According to our preliminary data this safe and cost-efficient technique induces long term alteration of neuronal network excitability resulting in increased synaptic activation of motoneurons.

In the course of our project we will perform several sets of experiment which will allow us to determine the immediate, prolonged and long-term impact of tsDC on motoneuron synaptic excitation and disease progression in SOD1 G93A mice. As these mice, harbouring a human mutated SOD1 gene, display an ALS phenotype similar to that observed in humans, the results of our investigations will have the potential to be further translated to human studies. We plan to use electrophysiological techniques to measure the effects of tsDC on motoneuron excitatory postsynaptic potentials in mouse spinal motoneurons, immunohistochemistry analysis to determine the impact of long-term tsDCS on motoneuron synaptic coverage, and finally functional tests to check if tsDCS affects mouse functional parameters and modifies disease progression. All experiments will be performed with agreement with the 3R principles and special care will be taken to minimize mice suffering and discomfort.

As a result of this project we expect to significantly improve our knowledge about the influence of externally induced electrical fields on motoneuron synaptic excitation and degeneration progression in ALS. If tsDCS is found successful in delaying the disease progression, this study will provide a solid background for the use of tsDCS as a novel, safe and cost efficient support to ALS management.