# Curriculum vitae

**Name:** Gergő A. Nagy

**Nationality:** Hungarian

**Date of birth:** 29.09.1990.

**Place of birth:** Budapest

**E-mail:** gerii.nagy@gmail.com

**University:** University of Szeged, Biology MSc, I.

**EDUCATION:**

- Budapest, Mihály Babits Secondary School (2009)
- Completed: University of Szeged, Biology BSc (graded excellent), 2012 – 2015
- In progress: University of Szeged, Biology MSc, 2015 – present
- (Other: Eötvös Loránd University, Biology, 2009-2011, not completed)

**LANGUAGES :**

- English, intermediate level (B2)

**RESEARCH EXPERIENCE:**

**RESEARCH INSTITUTES:**

**1.**
- **Supervisor:** Norbert Hájos, PhD, DSc
- **Institution**: Institute of Experimental Medicine of the Hungarian Academy of Sciences
- **Laboratory:** ’Lendület’ Laboratory of Network Neurophysiology

**2.**
- **Supervisors:** Antonio Fernández-Ruiz, PhD; Azahara Oliva González, MSc; Antal Berényi, MD, PhD
- **Institution:** University of Szeged, Faculty of Medicine, Department of Physiology
- **Laboratory:** MTA-SZTE ‘Lendület’ Oscillatory Neuronal Networks Research Group

## SCIENTIFIC STUDENTS' CONFERENCES:

- 2012, Szeged – Biology Scientific Students' Associations Conference of University of Szeged ('TDK'), 2nd prize
- 2013, Szeged – National Scientific Students' Associations Conference ('OTDK'), 2nd prize

## PUBLICATIONS:

- Vereczki, V. K., Veres, J. M., Müller, K., Nagy, G. A., Racz, B., Barsy, B., & Hájos, N. (2016). Synaptic organization of perisomatic GABAergic inputs onto the principal cells of the mouse basolateral amygdala. *Frontiers in Neuroanatomy, 10*.
- Veres, J. M., Nagy, G. A., Vereczki, V. K., Andrási, T., & Hájos, N. (2014). Strategically positioned inhibitory synapses of axo-axonic cells potently control principal neuron spiking in the basolateral amygdala. *The Journal of Neuroscience, 34*(49), 16194-16206.
- Nagy, G. A., Botond, G., Borhegyi, Z., Plummer, N. W., Freund, T. F., & Hájos, N. (2013). DAG-sensitive and Ca2+ permeable TRPC6 channels are expressed in dentate granule cells and interneurons in the hippocampal formation. *Hippocampus, 23*(3), 221-232.
- Holderith, N., Németh, B., Papp, O. I., Veres, J. M., Nagy, G. A., & Hájos, N. (2011). Cannabinoids attenuate hippocampal gamma oscillations by suppressing excitatory synaptic input onto CA3 pyramidal neurons and fast spiking basket cells. *The Journal of physiology, 589*(20), 4921-4934

## POSTERS:

- Nagy, G.A., Fernández-Ruiz, A., Oliva González, A., Buzsáki, Gy., Berényi, A. (2016 IBRO, Budapest) Behavioral modulation of layer-specific activity in the entorhinal cortex.
- Fernández-Ruiz, A., Oliva González, A., Nagy, G.A., Buzsáki, Gy., Berényi, A. (2016 IBRO, Budapest) Cortical and intra-hippocampal gamma inputs compete or cooperate to control spiking dynamics during behaviour
- Veres, J. M., Vereczki, V. K., Müller, K., Nagy, G.A., Rácz, B., Barsy, B., Hájos, N. (2016 IBRO, Budapest) Synaptic organization of perisomatic GABAergic inputs onto the principal cells of the basolateral amygdala
- Vereczki, V. K., Veres, J. M., Végh, L., Nagy, G.A., Rácz, B., Vikor, A., Müller, K., Hájos, N. (2015 MITT, Budapest) Morphological characteristics of three distinct GABAergic interneuron types targeting the perisomatic region of principal cells in the mouse basolateral amygdala
- Nagy, G.A., Veres, J.M., Vikor, A., Rácz, B., Hájos, N. (2014 FENS, Milan) Target distribution of three distinct types of GABAergic interneurons in the basolateral amygdala
- Veres, J.M., Vereczki, V.K., Nagy, G.A., Rácz, B., Hájos, N. (2014 IBRO, Debrecen) Strategically positioned inhibitory synapses of axo-axonic cells potently control spiking of amygdalar principal neurons

- Veres, J.M., Nagy, G.A., Hájos, N. (2013 MITT, Budapest) Effective control of principal cell firing by fast spiking and regular spiking inhibitory cells in mouse basolateral amygdala
- Papp, O., Holderith, N., Németh, B., Veres, J.M., Nagy, G.A., Hájos, N. (2011 SiNAPSA Neuroscience Conference, Ljubljana) Suppression of excitatory synaptic inputs onto CA3 pyramidal cells and fast spiking basket cells by CB1 cannabinoid receptor activation results in the impairment of hippocampal gamma oscillations
- Nagy, G.A., Botond, G., Borhegyi, Zs., Freund, T.F., Hájos, N. (2011 MITT, Budapest) Subcellular distribution of TRPC6 channel proteins in the hippocampus.

**SCIENTIFIC AWARDS, SCHOLARSHIPS:**

- Excellent Student of Újpest (2009)
- National Conference of Scientific Students' Association (TUDOK) 1st award (2009)
- Scholarship of the Hungarian Republic (2014-2015)
- University of Szeged Talentpoint, List of Excellence, Silver Award (2015)
- Stephen W. Kuffler Research Scholarship (2016)

**RESEARCH INTEREST:**

Summary of the performed research:

A number of previous studies point out that rhythmic population activity, such as theta oscillations, play an important role in organizing the activity of different brain regions through modulating the firing properties and information processing of distinct cell assemblies during different behavioral states in the entorhinal-hippocampal circuit and in other brain areas (Buzsáki&Draguhn, 2004). The entorhinal cortex, providing the primary input to the hippocampus, consists of two different regions: the lateral (LEC) and the medial (MEC) entorhinal cortices. Theta oscillations in these regions have been shown to modulate spiking activity in the rat (Mizuseki et al., 2009; Schomburg et al., 2014). However, the mechanisms of theta coordination of neurons in the different layers of MEC and LEC and theta synchronization between MEC, LEC and the hippocampus during different behavioral states are largely unknown. To address these questions we employed large-scale silicon probes to record local field potentials (LFPs) and single-unit activity simultaneously in all hippocampal subfields and medial and lateral areas of the entorhinal cortex layers of rats during different behavioral tasks and sleep. Laminar recordings allowed us to characterize layer-specific LFP oscillations and spiking patterns.

Our preliminary analyses of LFP indicate that theta oscillations are present in MEC and also in LEC, although with lower amplitude, and are coherent with hippocampal oscillations. Moreover, current source density (CSD) analyses of LFP profiles reveal strong theta dipoles in layers III and II-I of both areas indicating at least two independent theta generators

Short description of the proposed research for the scholarship period:

Following the investigation of LFP oscillations, we aim to perform a detailed analysis of the spiking patterns of neurons in the entorhinal cortex of the rat. We hypothesize that in MEC and LEC different functional subtypes of principal cells and interneurons can be distinguished according to their theta-phase preference and firing rate dynamics. We expect that these cellular subpopulations also present behavioral dependent modulation during awake and sleep states and these changes in theta-phase preference, phase-locking strength and firing rate could reflect modulation of entorhinal inputs to different hippocampal regions according to behavioral demands.

To address these questions in my project I will perform surgeries implanting rats with multiple large-scale silicon probes and perform neuronal recordings daily for around 30 days per animal during different behavioral tasks and sleep. Furthermore, I will carry out deeper analyses of our dataset using built-in and custom-made software in Matlab. First, to separate single neurons from each other based on their extracellularly recorded spiking activity, I will perform manual cluster-cutting after an automatic spike-sorting process using the KlustaViewa software (http://klusta-team.github.io/index.html). Afterwards I aim to differentiate principal cells from interneurons in the distinct layers of MEC and LEC based on their autocorrelograms and waveform characteristics using custommade Matlab scripts. Subsequently I will implement further advanced analytical methods to determine whether based on their theta-phase preference, phase-locking strength and firing rate dynamics functional subtypes of principal cells and interneurons can be differentiated in MEC and LEC and assess if these subpopulations display different behavioral dependent modulation.

In summary the proposed research aims to address the hypothesis that theta rhythmic population dynamics in the rat entorhinal cortices occurs in a region- and layer-specific manner during different behavioral states.

References:


- Buzsáki, G., &Draguhn, A. (2004). Neuronal oscillations in cortical networks. Science, 304(5679), 1926-1929.
- Mizuseki, K., Sirota, A., Pastalkova, E., &Buzsáki, G. (2009). Theta oscillations provide temporal windows for local circuit computation in the entorhinal-hippocampal loop. Neuron, 64(2), 267-280.
- Schomburg, E. W., Fernández-Ruiz, A., Mizuseki, K., Berényi, A., Anastassiou, C. A., Koch, C., & Buzsáki, G. (2014). Theta phase segregation of input-specific gamma patterns in entorhinal-hippocampal networks. Neuron, 84(2), 470-485.