

Active dendrites and their role in memory assemblies

Panayiota Poirazi^{1*}

¹ *Institute of Molecular Biology and Biotechnology (IMBB), Foundation for Research and Technology-Hellas (FORTH), Heraklion, Crete, GREECE*

*poirazi@imbb.forth.gr

Abstract:

The goal of this presentation is to provide a set of predictions generated by biophysical and/or abstract mathematical models regarding the role of dendrites in information processing, learning and memory across different brain regions. I will present modelling studies from our lab –along with supporting experimental evidence- that investigate how dendrites may be used to facilitate the learning and coding of both spatial and temporal information at the single cell, the microcircuit and the neuronal network level. I will present the main findings of a number of projects in lab dealing with dendritic nonlinearities in PV interneurons and their consequences on memory engram formation [1], the role of dendrites in solving nonlinear problems in human neurons [2] and microcircuit contributions to spatial learning in the CA1 [3,4].

[1] Tziliavaki A, Kastellakis G, Poirazi P. Challenging the point neuron dogma: FS basket cells as 2-stage nonlinear integrators. *Nat Commun.* 2019 Aug 14;10(1):3664. doi: 10.1038/s41467-019-11537-7.

[2] Gidon A, Zolnik TA, Fidzinski P, Bolduan F, Papoutsis A, Poirazi P, Holtkamp M, Vida I, Larkum ME. Dendritic action potentials and computation in human layer 2/3 cortical neurons. *Science.* 2020 Jan 3;367(6473):83-87. doi: 10.1126/science.aax6239.

[3] Turi GF, Li WK, Chavlis S, Pandi I, O'Hare J, Priestley JB, Grosmark AD, Liao Z, Ladow M, Zhang JF, Zemelman BV, Poirazi P, Losonczy A. Vasoactive Intestinal Polypeptide-Expressing Interneurons in the Hippocampus Support Goal-Oriented Spatial Learning. *Neuron.* 2019 Mar 20;101(6):1150-1165.e8. doi: 10.1016/j.neuron.2019.01.009. Epub 2019 Jan 31.

[4] Shuman T, Aharoni D, Cai DJ, Lee CR, Chavlis S, Page-Harley L, Vetere LM, Feng Y, Yang CY, Mollinedo-Gajate I, Chen L, Pennington ZT, Taxis J, Flores SE, Cheng K, Javaherian M, Kaba CC, Rao N, La-Vu M, Pandi I, Shtrahman M, Bakhurin KI, Masmanidis SC, Khakh BS, Poirazi P, Silva AJ, Golshani P. Breakdown of spatial coding and interneuron synchronization in epileptic mice. *Nat Neurosci.* 2020 Feb;23(2):229-238. doi: 10.1038/s41593-019-0559-0.