

CAJAL BLUE BRAIN PROJECT

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Cajal Blue Brain Project: Year nine

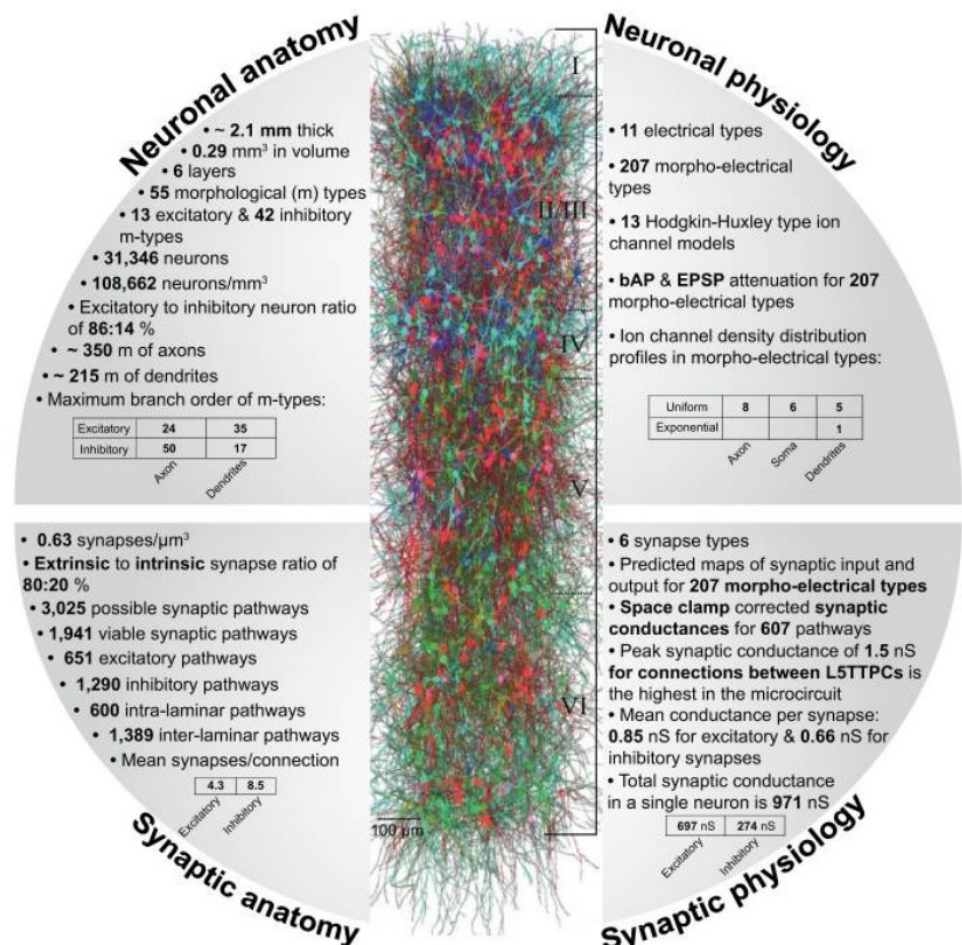
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The ninth project year has closed with additional functional and physiological data necessary to unravel the structural design of the cortical column through microanatomical and electrophysiological techniques and application of informatics tools. In part this progress has been possible thanks to the incorporation of the research line “physiological and functional modeling”, started in 2016, and the integration with the anatomical data obtained. These anatomical and physiological studies in anesthetized and awake animals will be used for upgrading the modelling of the mouse somatosensory cortex at the cellular level (developed by the BBP, and further enhanced during the Ramp-Up phase (Markram et al, 2015)) and generate more realistic cortical models. Validation and refinement will be performed in collaboration with the BBP and with other HBP collaborators. Thus, it will have access to the full set of models, tools and workflows developed by the BBP, which will be released as Open Source Software, and made available through the Brain Simulation Platform of the HBP.

Special points of interest:

Developed software/technical tools





2017 Main Achievements

2017 Main Achievements

Neuroscience

- Additional data necessary to unravel the structural design of the mouse cortical column by means of microneuroanatomical techniques and the application of informatics tools.
- Influence of cerebral blood vessel movements on the position of perivascular synapses (Urrecha M, PLoS One. 2017 Feb 15; 12(2):e0172368).
- GSK-3 β Overexpression Alters the Dendritic Spines of Developmentally Generated Granule Neurons in the Mouse Hippocampal Dentate Gyrus (Pallas-Bazarra N, Front Neuroanat. 2017 Mar 10; 11:18).
- Metabolomics and neuroanatomical evaluation of post-mortem changes in the hippocampus (Gonzalez-Riano C, Brain Struct Funct. 2017 Mar 11).
- Three-dimensional spatial modeling of spines along dendritic networks in human cortical pyramidal neurons (Anton-Sanchez L, PLoS One. 2017 Jun 29; 12(6):e0180400).
- Neuroanatomy and Global Neuroscience (DeFelipe J, Neuron. 2017 Jul 5; 95(1):14-18).
- High plasticity of axonal pathology in Alzheimer's disease mouse models (Blazquez-Llorca, L; Acta Neuropathologica Communications 2017).
- Volume electron microscopy of the distribution of synapses in the neuropil of the juvenile rat somatosensory cortex (Santuy A; Brain Struct Funct. 2017 Jul 18).
- Changes in neocortical and hippocampal microglial cells during hibernation (León-Espinosa G; Brain Struct Funct. 2017 Dec 19).
- Quantitative 3D Ultrastructure of Thalamocortical Synapses from the "Lemniscal" Ventral Posteromedial Nucleus in Mouse Barrel Cortex (Rodriguez-Moreno J; Cereb Cortex. 2017 Jul 28:1-17).

Data Analysis

- Three-dimensional spatial modeling of spines along dendritic networks in human cortical pyramidal neurons (Anton-Sanchez et al, 2017, PLoS ONE).
- Dendritic branching angles of pyramidal neurons of the human cerebral cortex (Fernandez-Gonzalez et al. 2017, Brain Structure and Function)
- 3D morphological-based clustering and simulation of human dendritic spines (Luengo-Sanchez et al. 2017, submitted to PLoS Computational Biology)
- A supervised classification of neocortical interneuron morphologies (Mihaljević et al. 2017, submitted to BMC Bioinformatics)

Neuroinformatics Tools & Visualization

- EspINA: Development of new versions (2.1.10 to 2.2.2), improving its stability and performance, while adding new tools and extending the performance of existing ones, and a Windows version for EspINA.
- Three-dimensional spatial modeling of spines along dendritic networks in human cortical pyramidal neurons (Anton-Sanchez et al, 2017, PLoS ONE).
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Cell Physiology Cajal's Laboratory

- In vivo recorders of the electrophysiological activity in anesthetized postnatal rats (P14-P16) in the somatosensory hindlimb cortex, using a multichannel arrays in terms of spikes, evoked potentials, LFPs and LFPs generators. The results obtained were quite different when compared to adults animals.
- Synapse-specific astrocyte gating of amygdala-related behavior (Martin-Fernandez, M et al., Nature Neuroscience)
- Synapse-Specific Regulation Revealed at Single Synapses Is Concealed When Recording Multiple Synapses (Lines, J et al., Frontiers in Cellular Neuroscience)
- Synaptic functions of endocannabinoid signaling in health and disease. (Araque, A et al., Neuropsychopharmacology)
- Insulin regulates astrocytic glucose handling through cooperation with IGF-I. (Fernandez AM et al., Diabetes)
- Neuron-astrocyte signaling is preserved in the ageing brain (Gómez-Gonzalo, M et al., Glia 65:569-580).

Developed software/technical tools

The methods developed in the project are expected to be transferred and/or disseminated to the scientific community after an assessment period carried out by the users. :

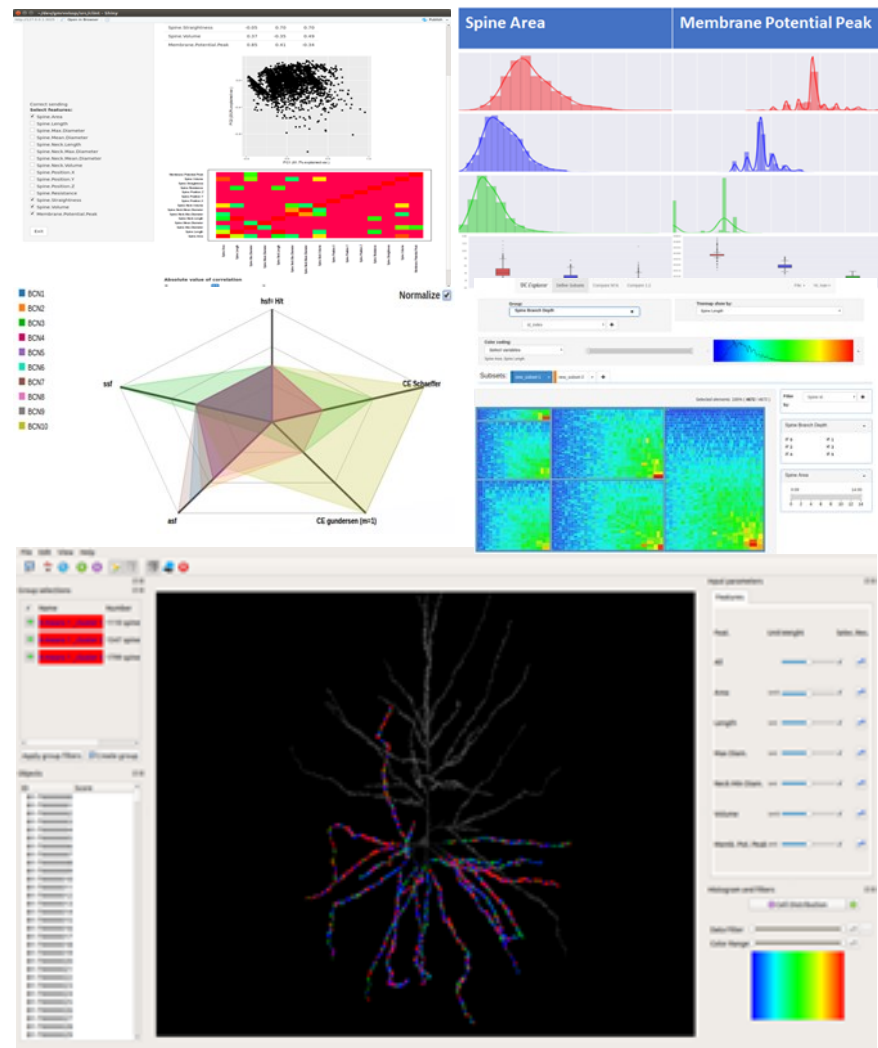
Data Analysis:

3DSpineMFE
spineSimulation
3DBasalRM
MultiMap
Electro-Morpho

Neuroinformatics Tools and Visualization:

- EspINA
- EspINA data visualization and analysis
- Pyramidal Explorer (<http://gmr.es/pyramidalexplorer>)
- DCExplorer (http://cajalbbp.es/dcexplorer_web/)
- Clint Explorer
- InToolExplorer (<https://cajalbbp.es/intoolexplorer>)
- ViSimpl (<http://gmr.es/visimpl>)

Developed software/
technical tools



Overview of the interactive visualization tools framework



CONTACT DETAILS

Cajal Cortical Circuits Laboratory
Center for Biomedical Technology (CTB)
Parque Científico UPM
Campus de Montegancedo s/n
28223 Pozuelo de Alarcón
Madrid, Spain
E-mail: info@cajalbbp.com



CTB

The Cajal Blue Brain Project is hosted by the Universidad Politécnica de Madrid (UPM) in the Scientific and Technological Park of Montegancedo Campus. Computational needs and support infrastructure required by CajalBBP are provided by two of the Research Centers of the Park, the Centro de Tecnología Biomédica (CTB) and the Centro de Supercomputación y Visualización de Madrid, CeSViMa, which is focused on the massive storage of information, high-performance computing and advanced interactive visualization.

More information: www.ctb.upm.es



Sponsorship



