CAJAL BLUE BRAIN PROJECT

Volume 9, issue 17. June 2017

BLUE BRAIN

Cajal Blue Brain Project: Year nine

INSIDE THIS ISSUE:

Cajal Blue Brain Pro- ject: Year nine	1
2017 Main Research Activities	2
Dissemination Activities	3

During the ninth project year, the scientific modules are working to obtain the main objectives proposed in the scientific work plan, such as additional data necessary to clear up the structural and functional design of the mouse cortical column by microanatomical and electrophysiological techniques. In addition, informatics tools are being improved to achieve neocortical models of the structure and function of column cortex, particulary cortical columns in rats. The *in vivo* data obtained during the first six months on the electrophysiology characteristics of the cortical column of postnatal P14 rats represents a major achievement. This is because those data was critical for the comparative in vivo/in silico studies that were going to perform in collaboration with our colleagues of the BBP and HBP during 2018. Furthermore, new tools are being developed to allow users interact with the column data, modifying the morphological and electrophysiological characteristics of the cells, as well as their location or density onto the cortical column. The integration structural and functional data into these new tools will allow us understand the function and design of the cortical column, in physiological and pathological conditions.



Special points of interest:

Dissemination Activities



2017 Main Research Activities

The main research activities in which the scientific modules are currently working on are as follows: **Neuroscience**

- Development a new tool which improved the correlative method between the study of semithin sections by light and electron microscopy (published).
- In vivo data on the electrophysiological characteristics of the cortical column in postnatal P14 rats.
- Model dealing with the relationship between blood vessel movements and perivascular synapses in cortical columns (published).
- Studies of multivesicular bodies presence in the neocortical neuropil, and their relationship with the mitochondria, as well as, the distribution of mitochondria in different cortical layers and cellular compartments (publication is currently in preparation).
- Digitalization in 3D confocal stacks of images of apical and basal arbors of pyramidal cells across all cortical layers layers (II, III, IV, Va,Vb and VI), as well as, reconstructed several apical and basal arbors of pyramidal cells, including the position of spines in all cortical layers (II, III, IV, Va,Vb and VI).
- The distribution of excitatory and inhibitory synapses on dendritic spines and dendritic shafts in the six neocortical layers (published), beside the quantitatively of their sizes and shapes in the neuropil of the somatosensory cortex (published).
- The distribution of the astrocytes and their relationship with synapses (publication is currently in preparation).
- Development a software tool to trace the path that axons and dendrites follow within a stack of electron microscope serial images (Tool under tested).

Data Analysis

- Update and improve ImageJ/FIJI plugins and toolset and are available in the github page of the CIG group. Completion of the release of MultiMap software (named Atlas in 2016 report) for displaying and analyzing spatial data extracted from confocal images (<u>https://github.com/</u> <u>ComputationalIntelligenceGroup/MultiMap</u>).
- Development and testing of the algorithm of MultiMap application in confocal images. The MultiMap application is being developed as a general application for dealing with spatial data over images; hence applications to cell images are straightforward.
- Developing a more expressive hybrid model with the aim of improving the clustering and simulation results obtained by the algorithm developed in 2016

Neuroinformatics Tools & Visualization

- A fully operative tool are being developed for the extraction of neurite skeletons from EM stacks. This tool will allow users to interactively extract, edit and annotate neurite skeleton fragments during the acquisition process, while displaying the acquired skeletons overlaid on the original stack, in two and three dimensions.
- A new automatic segmentation algorithm for synapses and mitochondria has been incorporated into the EspINA framework during 20187 according to the work plan.
- A new version of EspINA for the Windows OS has been released, aiming to facilitating the dissemination of EspINA among non-Linux users. This version is still in the testing phase and its public release has been delayed due to insufficient internal use, which has prevented the performance of comprehensive tests (the Linux version is still prevalent among CBB users because most of them are accustomed to it and have it already available).

Cell Physiology Cajal's Laboratory

- Monitoring simultaneously astrocyte calcium imaging through two-photon microscopy and neuronal electrical activity through electrocorticogram (ECoG) recordings in vivo.
- Astrocytes in the layer 2/3 of the primary somatosensory cortex respond with calcium elevations to the sensory stimulation evoked by electrical stimuli of the forelimb or hindlimb and in response to calcium elevations to agonists of serotoninergic receptors, indicating that astrocytes sense sensory inputs to the cortex and astrocytes express functional serotoninergic receptors respectively.
- Astrocyte population response depends on the intensity, frequency, and duration of the sensory stimulus, indicating that astrocytes sense the degree of neuronal and synaptic activity.
- Selective activation of cortical astrocytes is sufficient to alter the ECoG activity, indicating that astrocyte activity influences cortical neuronal network activity *in vivo*, and suggesting that cortical function results from the coordinated activity of astrocytes and neurons.

2017 Main Research Activities



Dissemination Activities

Web Site and social Networks.





	twitter	(d) Busine	Chanas County? Beccar service -
Cajal BLUE BR/	CajalBBP CajalBBP Canada BLUE B		RAIN
COLOC DIV	Permanece en contacto con	Tweets	- Carlo Carlo Carlo
BLUE BR	Create a Turther hey misma Transe a Turther hey misma Transe complete	Charter Vicuntor Charter Vicgramaccin de aptractores o docentors en la Facutad de Informática I	RAIN
Cajal RI LIF BR	Contractions Contraction Restriction	Content Content COLO COLONADACIA Cast Bue In web castop resima concer (Visiance)	
X Calal	Tuests 3	Case thus than Project extrema nueva a philamost	et capitap cervina spin in
BLUE BR/	Inguistres 2	Capiter Country Capit Due brain Project amanca en twite	RAIN
BLUE BR		3	RAIN
BLUE BR	4 2012 Valler Solve musikus Ayuda Diemess Phasatolat Bing Kolade Aphracises Restances Depletes Published Approxis Resta Descentrationes		

https://twitter.com/CajalBBp

Dissemination Activities

Dissemination activities

r

Type of Activity	Title	Date	Event	Place	Type of Audi- ence
Presentation	Presentation Flag- Era HBP Madrid	12/01/2017	FLAG-ERA JTC 2017 infor- mation day	Universidad Autónoma de Madrid	Scientific Community and Civil Society
TV Interview	Los 7 pecados Capitales	13/01/2017	Documental sobre la historia de Madrid	Madrid	Scientific Community and Civil Society
Conference	Semejanzas entre el universo y el mundo microscópico del cerebro: dos mun- dos paralelos	17/02/2017	XIV Curso de Invierno de Epilepsia	La Granja (Segovia)	Scientific Community and Civil Society
Conference	Los pilares del HBP desde la óptica científica.	23/02/2017	1º Foro HBP y su impacto en la Insdustria Española	Madrid	Scientific Community and Civil Society
Conference	Cognición y Circui- tos Corticales	10/03/2017	Reunión de Expertos: trata- miento clínico de la depresión	Madrid	Scientific Community and Civil Society
Conference	The Blue Brain/ Human Brain Pro- ject	25/03/2017	WADD	Madrid	Scientific Community and Civil Society
Conference	La Conectividad cerebral: el Cajal Visionario	31/03/2017	XIV Reunión de la Sociedad Andaluza de Epilepsia	Málaga	Scientific Community and Civil Society
Conference		05/05/2017	Conferencia en el ICOM	León	Scientific Community and Civil Society
Conference	Brain connectomics: exploring the connectome and synaptome	27/06/2017	International Workshop "Different elements of pri- mate neural networks in the connectome era	Pavia (Italia)	Scientific Community and Civil Society













СТВ

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, bigh-performance computing and advanced

high-performance computing and advanced interactive visualization.

More information: www.ctb.upm.es





Sponsorship



