

# CAJAL BLUE BRAIN PROJECT

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## Cajal Blue Brain Project

### 2015 Project Reorganization

At the end of 2015 the project was reorganized as agreed in the SMC meeting held on May 26<sup>th</sup> and according to the 2012 procedures. The reorganization was implemented to make the most of the project resources ensuring the accomplishment of the objectives in the final three-year phase of the project. This new organization includes, on the one hand, a new research aspect focused on physiology and modelling, and on the other hand, a re-organization of the scientific modules. The modules 'Visualization' and 'Informatics Tools' were merged with the Visualization external group (GMRV). As a result, two new modules have been established: Neuroinformatics Tools & Visualization and Exploratory Data Analysis.

The main aim of these modules during the final three-year phase of the CBBP is as follows:

- **Neuroinformatics tools:** The developments carried out in the Visualization module (UPM) and exploratory analysis, together with the analysis developed by other groups involved in the project, will be integrated into EspINA. This tool will provide image analysis and segmentation algorithms as well as analysis and visualization of data and exploratory analysis.
- **Visualization and Exploratory Data Analysis:** In the area of segmentation and image analysis, EspINA will include the development of image analysis algorithms, facilitating the integration of methods developed by other research groups. The first method to be developed will be based on the progressive automation of the spines segmentation methods with haptic support.

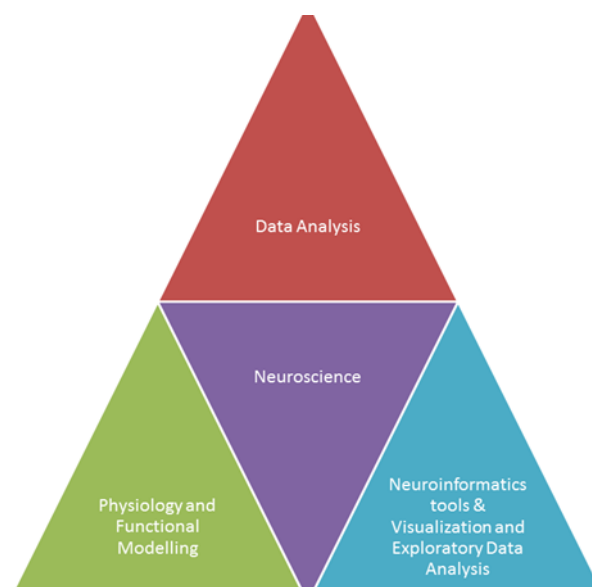
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Project structure for 2016-2018

New research line in the core project: Physiology and Functional Modeling



General scheme of the core project

## Physiology and Functional Modelling

### 2015 Cajal Blue Brain Project

#### New Research Line in the Core Project: *Physiology and Functional Modelling*

The digital reconstructions described by the team of the Blue Brain Project (Markram et al., Reconstruction and Simulation of Neocortical Microcircuitry. Cell. 163:456-92, 2015) aimed to recreate the anatomy and physiology of an isolated slice of neocortical tissue, but not specifically to replicate any particular *in vivo* experiment. Nonetheless, we tested the ability of the digital reconstruction to replicate such experiments. We found that digital reconstructions reproduce a number of findings from *in vivo* studies, allowing deeper investigation of their underlying cellular and synaptic mechanisms. They also enable experiments that have not so far been possible either *in vitro* or *in vivo*. Thus, to further test this potential, in 2015 the implementation a new research aspect was involved in the project 'Physiology and Functional Modelling' by combining *in-vivo* electrophysiology recordings together with the study of the cortical generators of local field potentials and biophysical model of activity in segments of the cortical column.

#### Physiological and functional modelling laboratories.

There are four research laboratories involved in this new area of the project together with the Neuroscience Module: Hospital Clínico San Carlos, Experimental Neurophysiology Laboratory, Clinical Neuroscience Laboratory and Experimental and Computational Electrophysiology from the IC-CSIC.

A description of these laboratories is as follows:

#### Clínico San Carlos Hospital

Prof. Ulises Gómez Pinedo is the head of the Laboratory of Basic Neuroscience of the Instituto de Investigación Sanitaria San Carlos. His laboratory has conducted a great number of pre-clinical models and has been in charge of the translation to clinical trials currently implemented. The group's expertise includes histological, biochemical and molecular analysis, as well as neurophysiological and behavioural evaluation.

#### Experimental Neurophysiology Laboratory

Prof. Juan de los Reyes Aguilar is the group leader of the Experimental Neurophysiology Laboratory at the Hospital Nacional de Paraplégicos in Toledo, where their main research interests and previous work involve the study of the somatosensory system, basic physiology and information processing. They are also interested in the physiological relationship between the structures of the somatosensory system, brainstem, thalamus and cerebral cortex. This group uses electrophysiological techniques, extracellular and intracellular recordings *in vivo* from brain structures as cerebral cortex, thalamus and brainstem.

#### Clinical Neuroscience Laboratory

The Laboratory for Clinical Neuroscience of the Center for Biomedical Technology is led by Prof. Bryan A. Strange, an expert in neurodegenerative diseases, iEEG and DBS in basic and clinical studies. This group's research is aimed at describing the cognitive alterations in neurological, neurodegenerative and neuropsychiatric diseases; analyzing the effects of DBS on cognitive and symptomatic improvement and overall improvement of the disease, and establishing therapeutic targets for new treatments in OCD and Alzheimer.

#### Experimental and computational electrophysiology (Herreras's Laboratory)

Prof. Oscar Herreras is leading a team at the Cajal Institute (CSIC) devoted to study brain electrophysiology and uses multidisciplinary approaches, and has accrued a variety of members with diverse background and training (biology, physics, mathematics, and informatics). They lean toward the biophysical mechanisms of neural processing and their abnormal manifestations in pathology.

Neural transmission and processing in the Nervous System is made through electrical messages between neuron assemblies arranged in circuits. Their complexity, and the large amount and variability of data flow are required to code numerous physical variables in a continuous manner. Part of this activity is picked up by local field potentials (LFPs), and, in turn part of these are picked up in the surface EEG. Herreras's team has developed a technique capable of reading the activity contributed by each different neuron population to LFPs/EEG. They use it to study (a) neural mechanisms of cognition and (b) their pathological alterations (migraine, brain stroke, neurodegeneration, epilepsy), with the purpose of detecting abnormal activity in early phases of brain illness, even ahead of external symptoms.

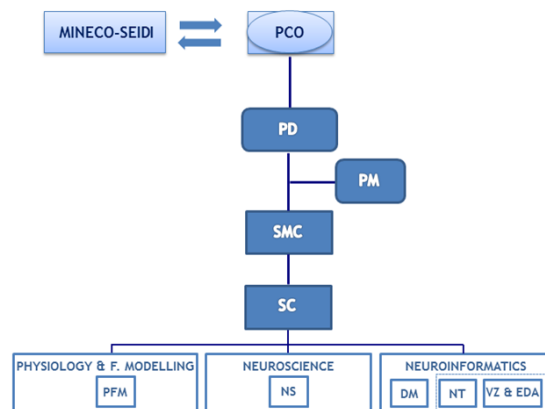
## 2015 Cajal Blue Brain Project

### Project Reorganization

At present, the project management comprises the following profiles and structures:

- Scientific Director
- Project Manager
- Scientific structures:
  - ◊ Neuroscience (NS):
    - \* Module NS: Neuroscience
  - ◊ Neuroinformatics (NI):
    - \*Module NI1: Data Analysis
    - \*Module NI2: Neuroinformatics tools & Visualization and Exploratory Data Analysis
  - ◊ Physiology and Functional Modelling (PM):
    - \*Module PFM: Physiology and Functional Modelling

### Project Reorganization



**MINECO-SEIDI:** Ministerio de Economía y Competitividad-Secretaría de Estado de Investigación, Desarrollo e Innovación  
**PCO:** UPM/CSIC: Universidad Politécnica de Madrid/ Consejo Superior de Investigaciones Científicas

**PD:** Project Director  
**PM:** Project Manager  
**SMC:** Strategic Management Committee  
**STC:** Scientific Committee

**NEUROSCIENCE:**  
**NS:** Neuroscience Module  
**NEUROINFORMATICS:**  
**NI1:** Data Mining Module (DM)  
**NI2:** Neuroinformatics tools & Visualization and Exploratory Data Analysis (VZ & EDA)  
**PHYSIOLOGY & MODELLING:**  
**FM:** Physiology and Functional Modelling

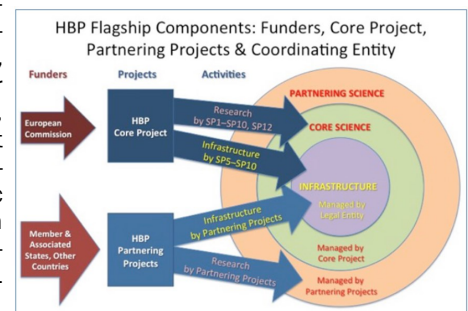
### The Human Brain Project-SGA1



### Human Brain Project

In the Framework Partnership Agreement (FPA), the HBP comprises a Core Project (CP), which will build and operate an integrated scientific Research Infrastructure (RI) comprising six ICT-based Platforms, and funded by the EC's FET Flagship Programme. The CP work also includes scientific research essential for the functioning of the RI. The CP is complemented by Partnering Projects (PPs), funded by regional, national, European, international and other sources. PPs will allow independent research groups to perform research that uses the HBP RI to address previously intractable issues, as well as adding novel capabilities to its Platforms. The CP's contribution to the HBP is divided into a series of distinct phases or grant agreements. The first of these was the Ramp-Up Phase, which ran from the start of the Project on 1 October 2013 to the end of March 2016. During this Phase, the HBP signed a Framework Partnership Agreement with the EC, which foresees the remainder of the 10-year HBP being divided into four successive Specific Grant Agreements (SGAs); the first three of which will last two years. The first Specific Grant Agreement (SGA1) and will last from 1 April 2016 to 31 March 2018.

### The Human Brain Project





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#### 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](http://www.ctb.upm.es)



## Sponsorship

