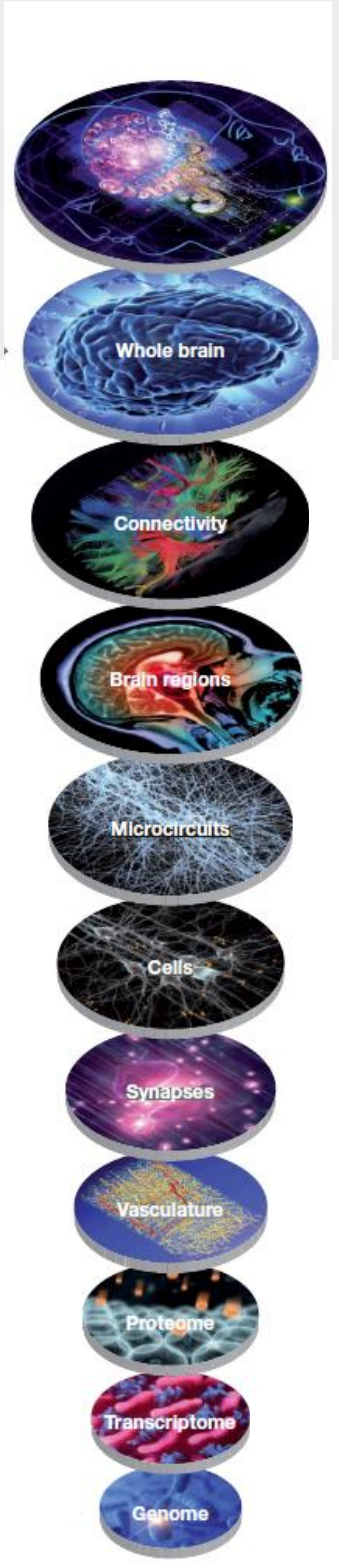
Human Brain Project

The Human Brain Project at a glance

Understanding the human brain is one of the greatest challenges facing 21st century science. If we can rise to the challenge, we can gain profound insights into what makes us human, develop new treatments for brain disease and build revolutionary new computing technologies. Today, for the first time, modern ICT has brought these goals within sight. Build a world-leading federated ICT infrastructure for Brain Research.

Human Brain Project



Understand the different organisational levels of the brain, such as:

- Molecular
- Cellular
- Brain region
- Whole brain

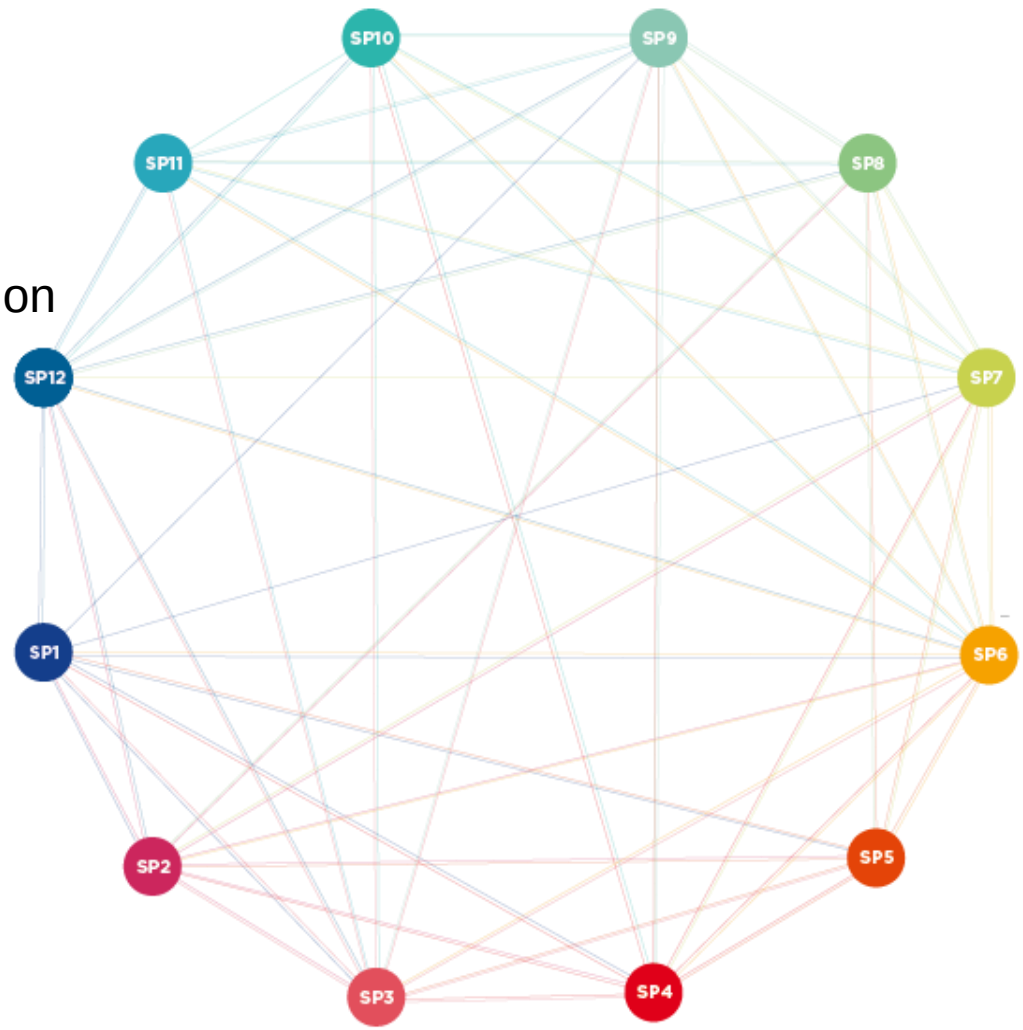
Develop

- Working simulation of the brain
- New technologies inspired by the functions of the brain
- New treatements for mental health disease

HBP Overview

Human Brain Project

The HBP is organized in twelve subprojects, spanning the development of six new informatics-based platforms, plus brain organisation, cognitive neuroscience, theory, ethics and society and management



The informatics-based platforms

Human Brain Project

Neuroinformatics

searchable atlases and analysis of brain data

Brain Simulation

building and simulating multi-level models of brain circuits and functions

Medical Informatics

analyzing clinical data to better understand brain diseases

Neuromorphic Computing

brain-like functions implemented in hardware

Neurorobotics

testing brain models and simulations in virtual environments

High Performance Computing

providing the necessary computing power

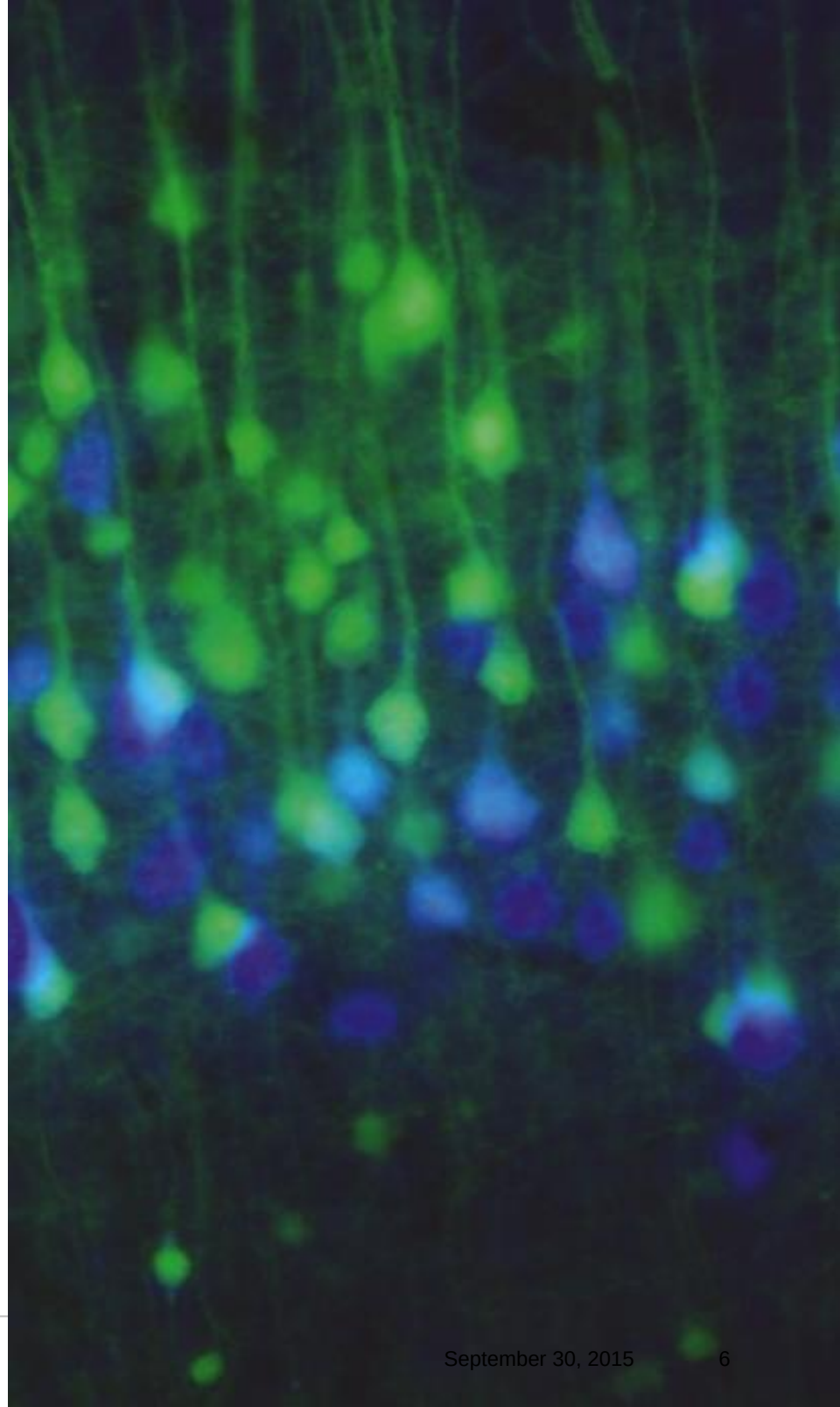
The next step: from platforms to a research infrastructure

- The HBP platforms are conceived to deliver access to the different aspects of the HBP
- The HBP as a whole is moving to become a European infrastructure for HPC-Based neuroscience
- HBP aims to be on the ESRFI roadmap by 2018
- The next phase 2016-2018 will see a strong scientific push along with an infrastructure building process.
- Infrastructure needs to be driven by the requirements of research (or else there will be no users). Cross-cutting projects and co-design projects are not only integrating the project but also provide a user-centric development of the tools and hardware requirements.
- Co-design projects are being created right now to bind the different platforms together

SP1

Mouse Brain Organisation

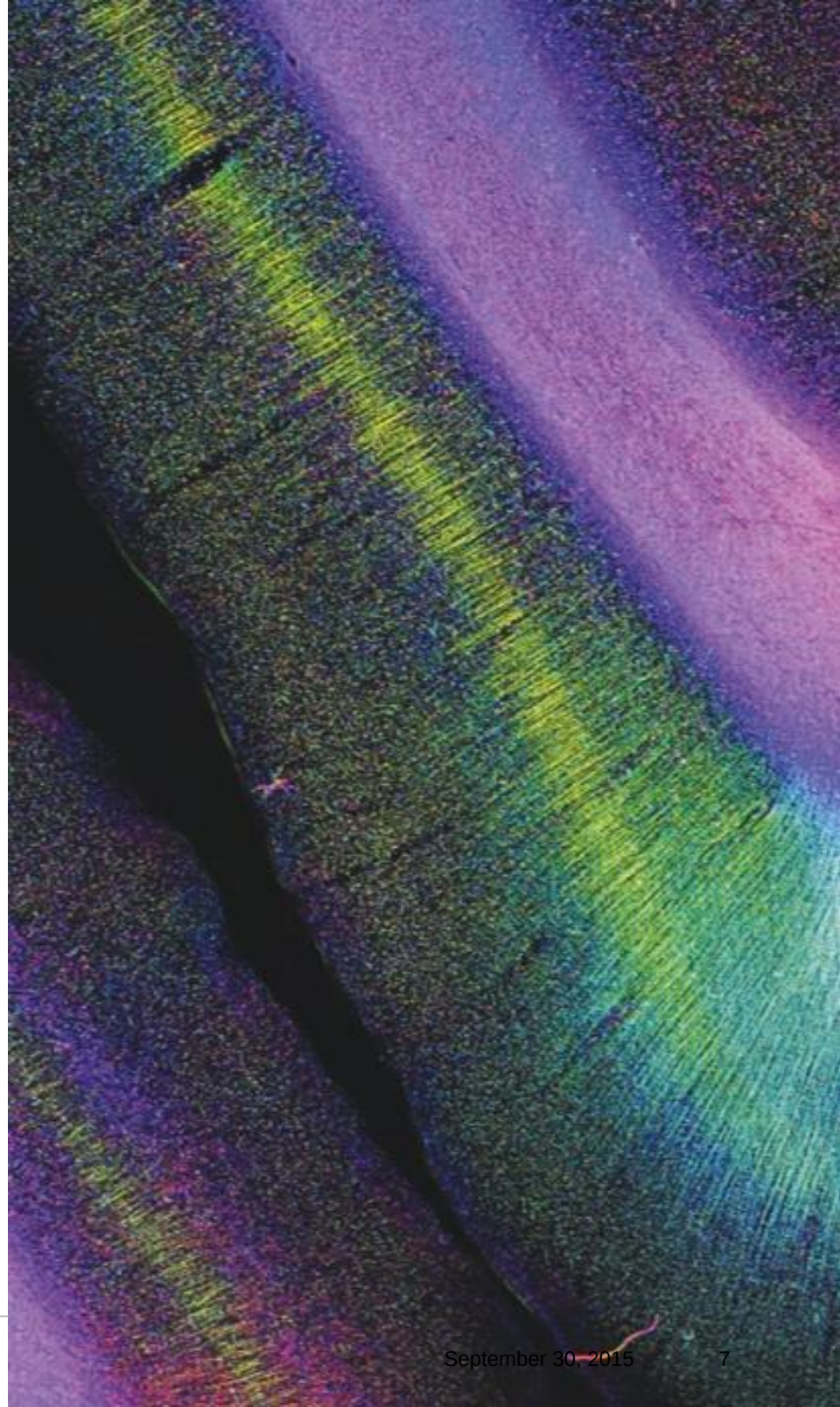
Researchers are using a combination of molecular and cellular approaches to contribute to our understanding of mouse brain structure. These data will facilitate a comparative understanding of the mouse and human brains and will be used in SP5's Mouse Brain Atlas



SP2

Human Brain Organisation

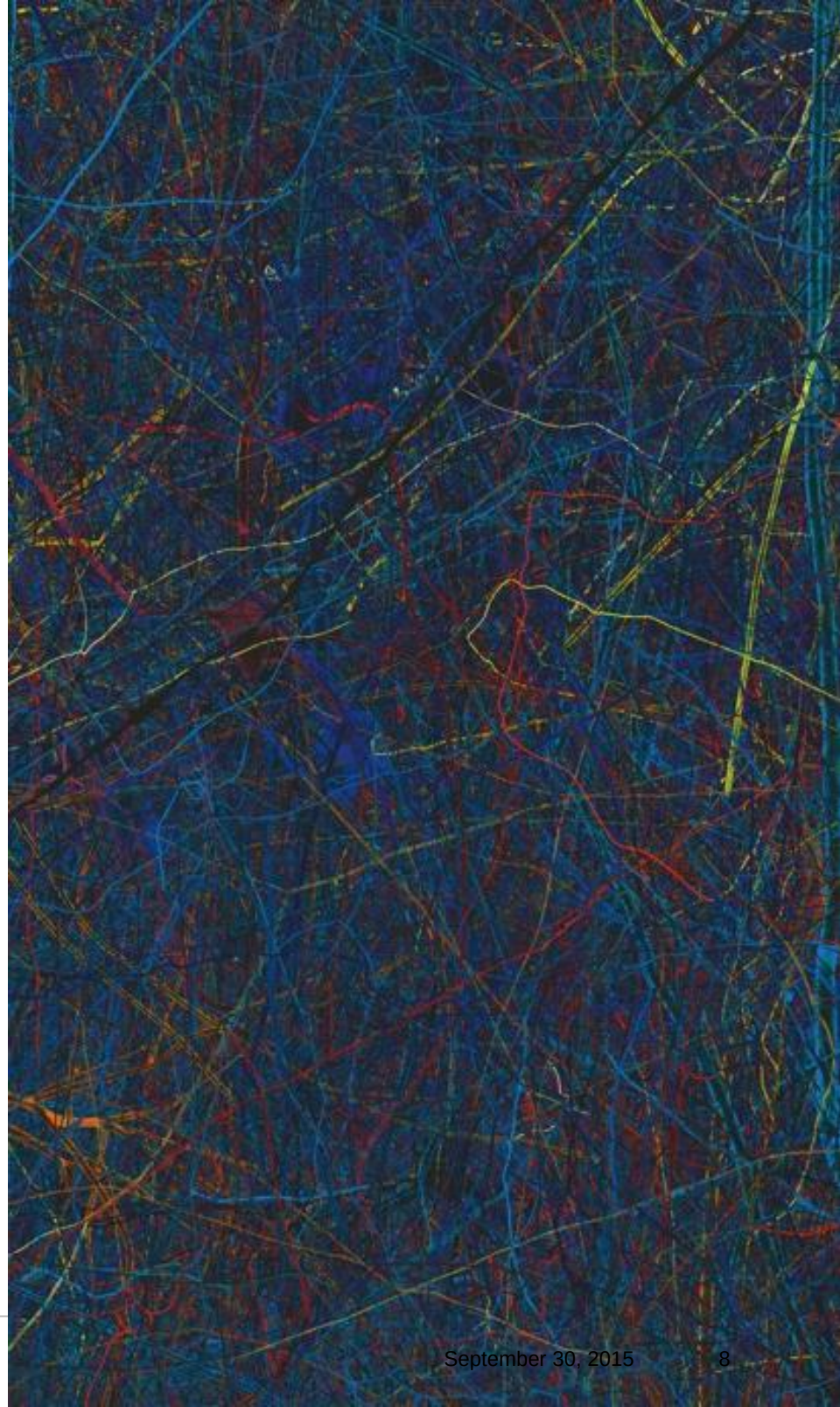
Using electron and light microscopy, optical imaging, and magnetic resonance imaging, SP2 researchers are collecting data on the structure and function of the human brain, including connections between regions and the numbers and shapes of different cell types. This information will go into SP5's Human Brain Atlas.



SP3

Systems & Cognitive Neuroscience

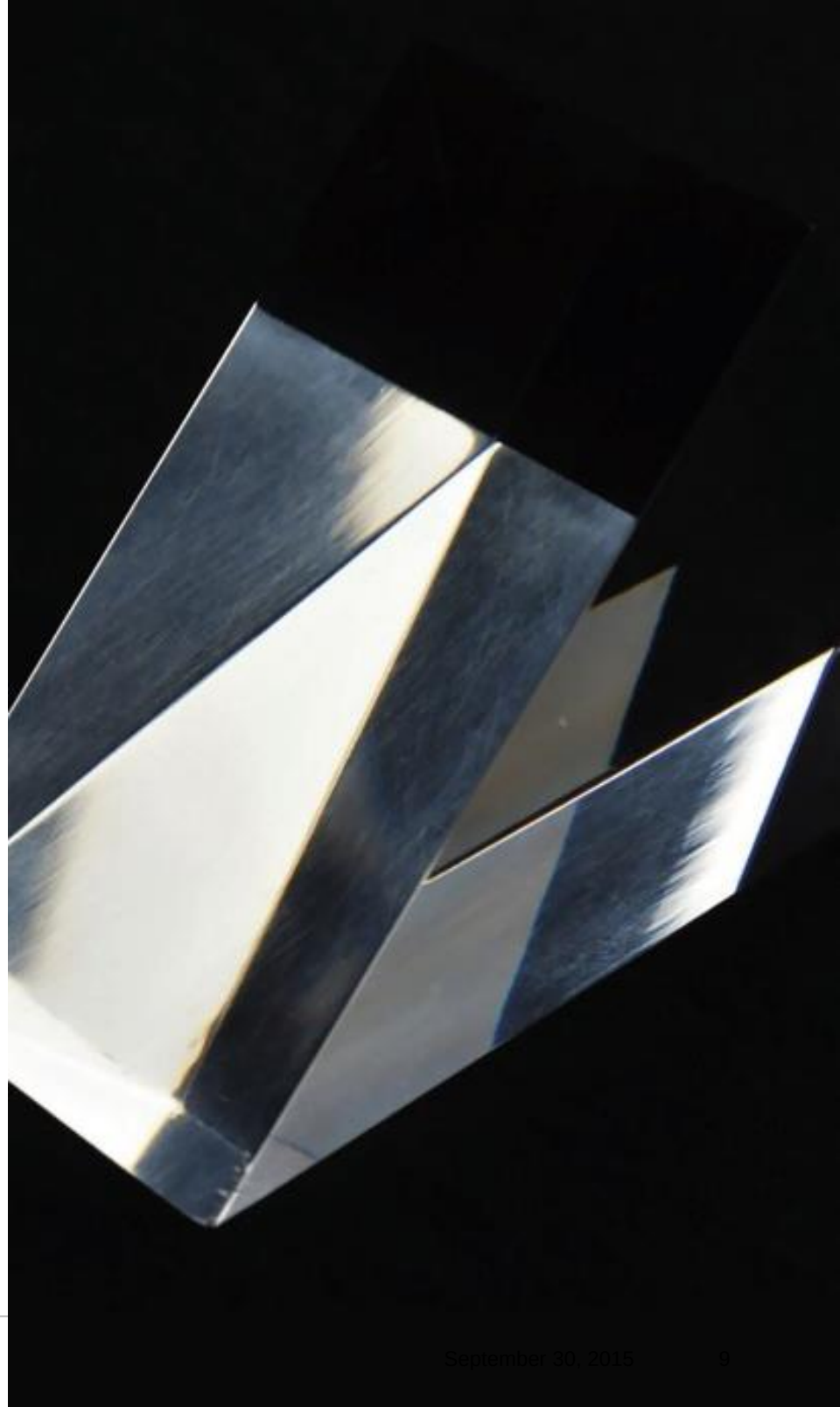
The content of SP3 will be defined by the present Call for Expressions of Interest.



SP4

Theoretical Neuroscience

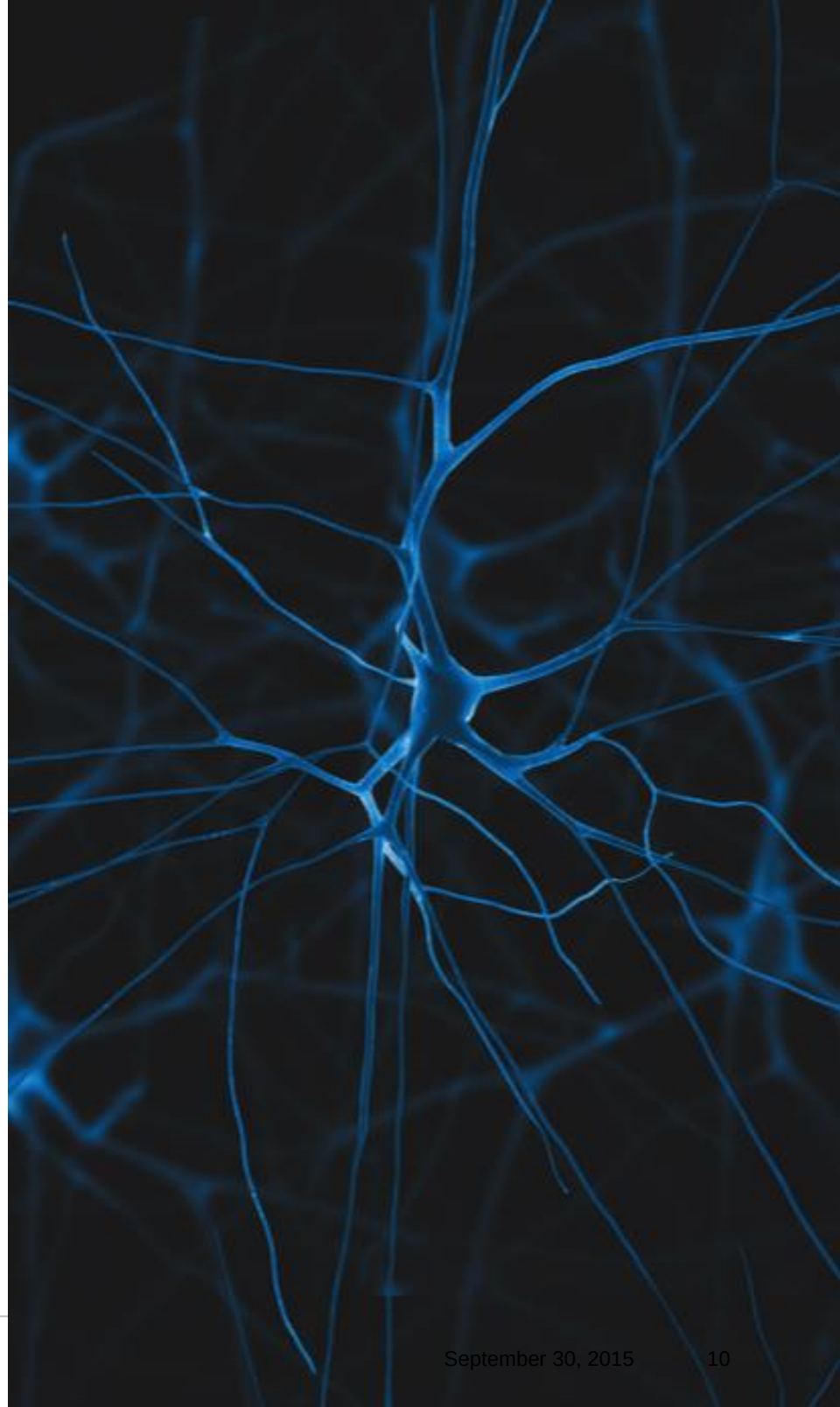
We identify key principles, to bridge the different scales of the brain, using top-down and bottom-up models, from interactions among molecules to the large-scale patterns of electrical activity observed in imaging studies, and to understand the basic principles underlying cognitive functions. SP4 has also established the European Institute for Theoretical Neuroscience (EITN) in Paris.



SP5

Neuroinformatics Platform

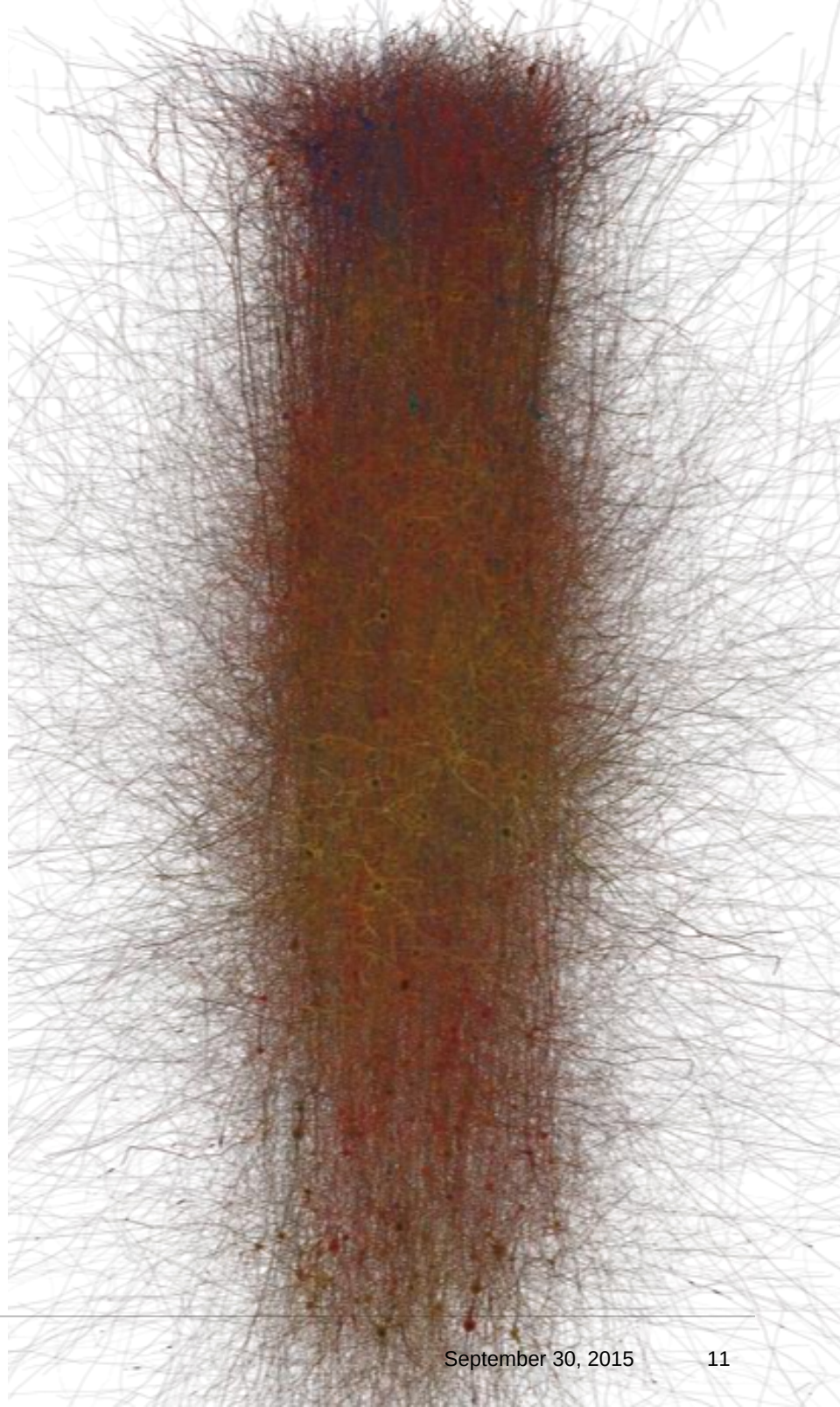
The Neuroinformatics Platform being developed by SP5 will allow neuroscientists to organize, search and access the massive volumes of heterogeneous data, knowledge and tools produced by the international neuroscience community. SP5 is also creating brain atlases (initially focused on rodent and human).



SP7

Brain Simulation Platform

We are developing the Brain Simulation Platform, a suite of software tools and workflows that allows researchers to build models of brain circuitry at different levels of biological detail, and to simulate the behaviour of the models on supercomputers.



High Performance Computing Platform

The High Performance Computing platform will provide the supercomputing, data and visualization hard and software capabilities required for multi-scale brain modelling, simulation and data analyses.

SP8

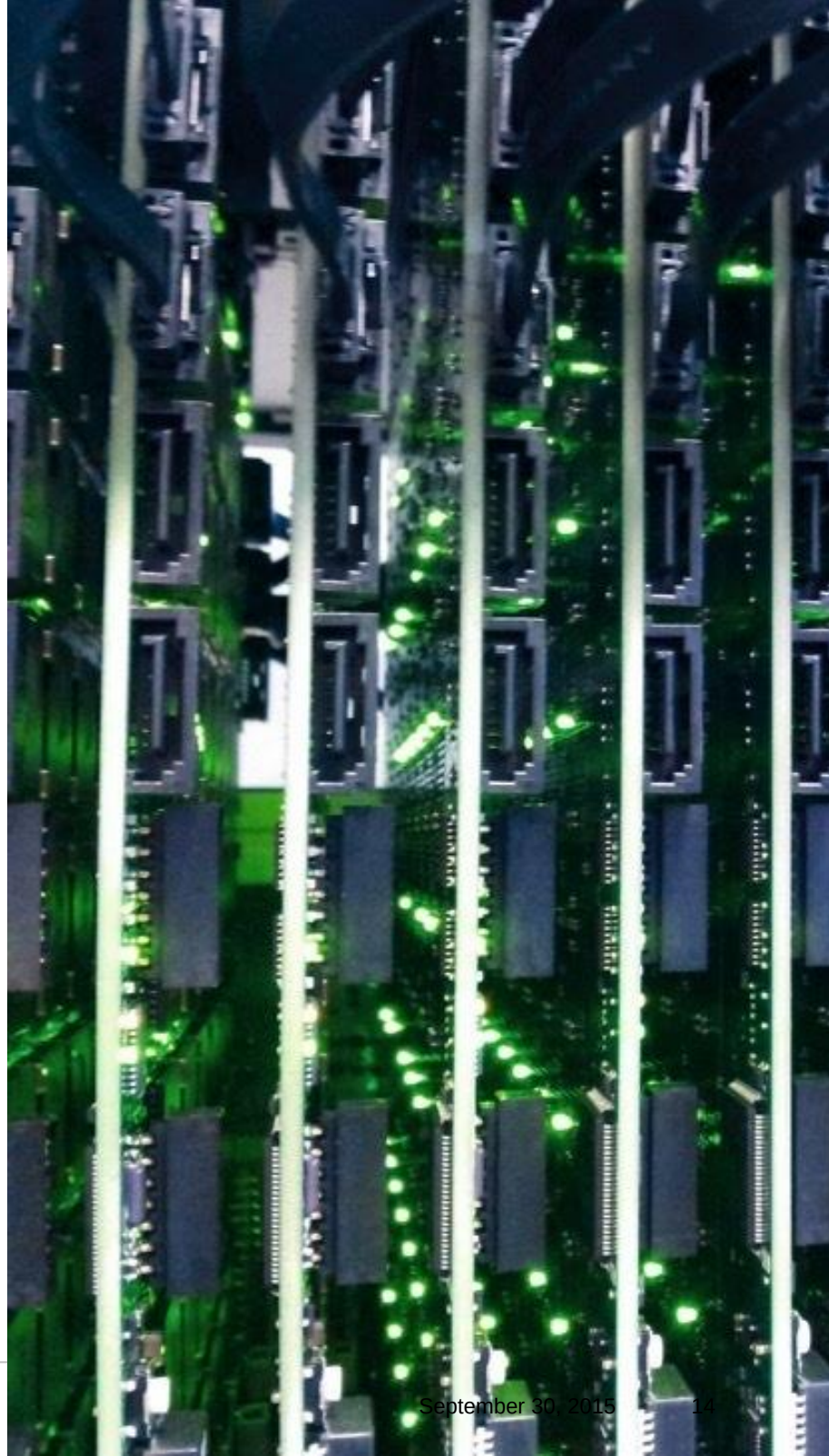
Medical Informatics Platform

The aim of the Medical Informatics Platform is to provide researchers the ability to access and analyse large amounts of anonymised patient data. Patterns in the data (“biological signatures of disease”) will lead to new classifications of brain disorders and more accurate diagnoses, paving the way for personalised medicine.

SP9

Neuromorphic Computing Platform

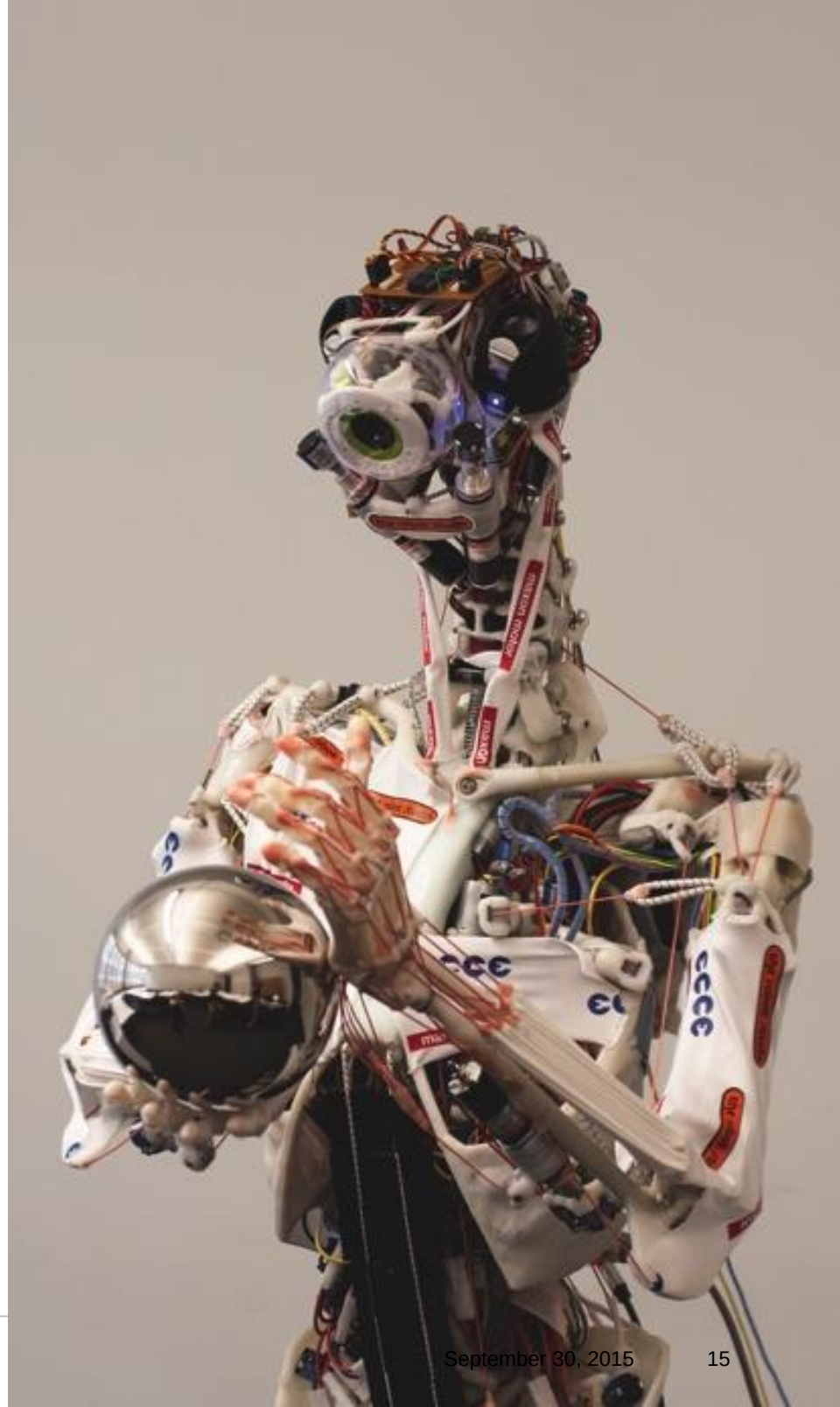
We are creating a new category of computing hardware, inspired by the circuitry of the brain, to overcome the fundamental limits of conventional IT technology. Our Platform will provide access to two complementary kinds of hardware systems. The first comprises very fast, energy-efficient analogue devices that emulate the physical processes in the brain; the second is based on very large numbers of digital computing devices.



SP10

Neurorobotics Platform

The Neurorobotics Platform will provide HBP brain models with a body, designing “closed loop” systems in which brain models are connected to simulated robots operating in a simulated physical environment. The Platform will make it possible to train brain models to perform specific functions and to replicate classical animal and human experiments.



SP11

Management

Management supports decision-making, operates the management structure, ensures transparency and accountability, and maintains quality and performance standards. It coordinates the HBP's science and technology activities and provides services for the whole Project: project management, IT, communications and outreach, innovation, legal affairs and the HBP Education Programme.

SP12

Ethics and Society

This team explores the social, ethical and philosophical implications of HBP's research, promoting engagement with decision-makers and the general public. Key themes arising from the new technologies developed by HBP include possible military applications, personal privacy implications, and our understanding of consciousness.

Crisis

Human Brain Project

Criticism of the HBP ('Open Letter')

- Governance
- Cognitive architecture

Remedial actions started early, bearing fruit now

- Philippe Gillet became President of the Board of Directors (BoD) in September 2014.
- In October 2104, the BoD decided to launch a mediation process under the chairmanship of Pr. Wolfgang Marquardt from Juelich.
- Concentration of power reduced

Clear guidance

Human Brain Project

March 2014

- Review from the EC. Positive review and the project was ranked as a good one that has fulfilled many of the expected goals after a year of existence.

March 2014

- Mediation Report. Recommendations on Governance and reinforcement of cognitive neurosciences

Real response

Human Brain Project

Actions

- Cognitive Neuroscience. Launch of a specific call for crosscutting activities (10% of the Core Budget) – **accomplished**

- Preparation of a new governance (Governance Working Group with directors of ESA, ESRF, CERN, NHI, EMBL, ESO, HELMOLTZ…) **accomplished**

Human Brain Project

Call for Expressions of Interest on Systems and Cognitive Neuroscience

Call published online: 15 May 2015

Deadline for submissions: 3 July 2015 at 17:00 CET

Selected projects announcement: mid-September 2015

4 projects were selected, total of 8 million EUR

Achievements

Human Brain Project

- Calls
  Competitive Calls, FLAG-ERA Joint Transnational Call, yielded the first 6 partnering projects funded by National Research Funding Agencies
- Number of papers
  101 publications as of M18 – HBP acknowledged
- Outreach
  5 Education workshops, 4 Theory & Ethics workshops, 2 Summits, 1 Museum Program Workshop)
- Existing partnering projects
  5 projects from JTNC, one EC-funded project on impact assessment
- Platforms achievements
  We are currently receiving achievements for year 2

Year one achievements -examples-

Human Brain Project

SP1 Strategic Mouse Brain Data

- Single-cell transcriptomics: Methods for identifying all the genes expressed in single neurons have been developed and tested, making large-scale screening of the genetic types of cell in the mouse brain technically feasible. Initial single-cell transcriptomes suggest that each neuron expresses 3-4,000 of roughly 20,000 total genes.

SP2 Strategic Human Brain Data

- BigBrain reconstruction: A human *post mortem* brain has been processed, 3D reconstructed, and published as BigBrain data (Amunts et al., Science 2013). The challenges of unifying different scales and data types into a common reference system for human brain modelling are outlined by Amunts et al. in *Neuroimage* (2014).

SP3 Cognitive Architectures

- Architectures for decision and confidence: A new task has revealed behavioral evidence that human subjects can base both primary decisions and confidence judgments on close-to-optimal computations with statistical distributions.

SP4 Theoretical Neuroscience

- Initial simplified models: Simplified neuron models that account for dendritic input processing have been completed.

SP5 Neuroinformatics Platform

- Data set assembled: Data on neuronal, glial and synaptic proteomics, neocortical, microcircuitry, whole mouse brain, and whole brain tracts have been identified and are being integrated into the first draft of the Neuroinformatics Platform

Year one achievements

Human Brain Project

SP6 Brain Simulation Platform

- Molecular models: Prototype software and workflows have been developed for automated loading, distribution and specification of reactions between molecules in neurons.

SP7 High Performance Computing Platform

- Operational supercomputers: Four HBP supercomputers are ready for use by the HBP: the HBP Development Supercomputer at CSCS in Switzerland, the HBP Supercomputer for Brain Modelling and Simulation at Juelich in Germany, the HBP Massive Data Analytics Supercomputer at CINECA in Italy, the HBP Molecular Dynamics Supercomputer at BSC in Spain.

SP8 Medical Informatics Platform

- Local data store: Specification of the tools for data extraction and integration of patient data have been established and implement in one hospital (CHUV). The requirements analysis for the anonymisation of patient data and the pre-selection of candidate solutions has been completed. Architecture of HBP-MIP local nodes, including databases and query engine, has been defined and a prototype created.

SP9 Neuromorphic Computing Platform

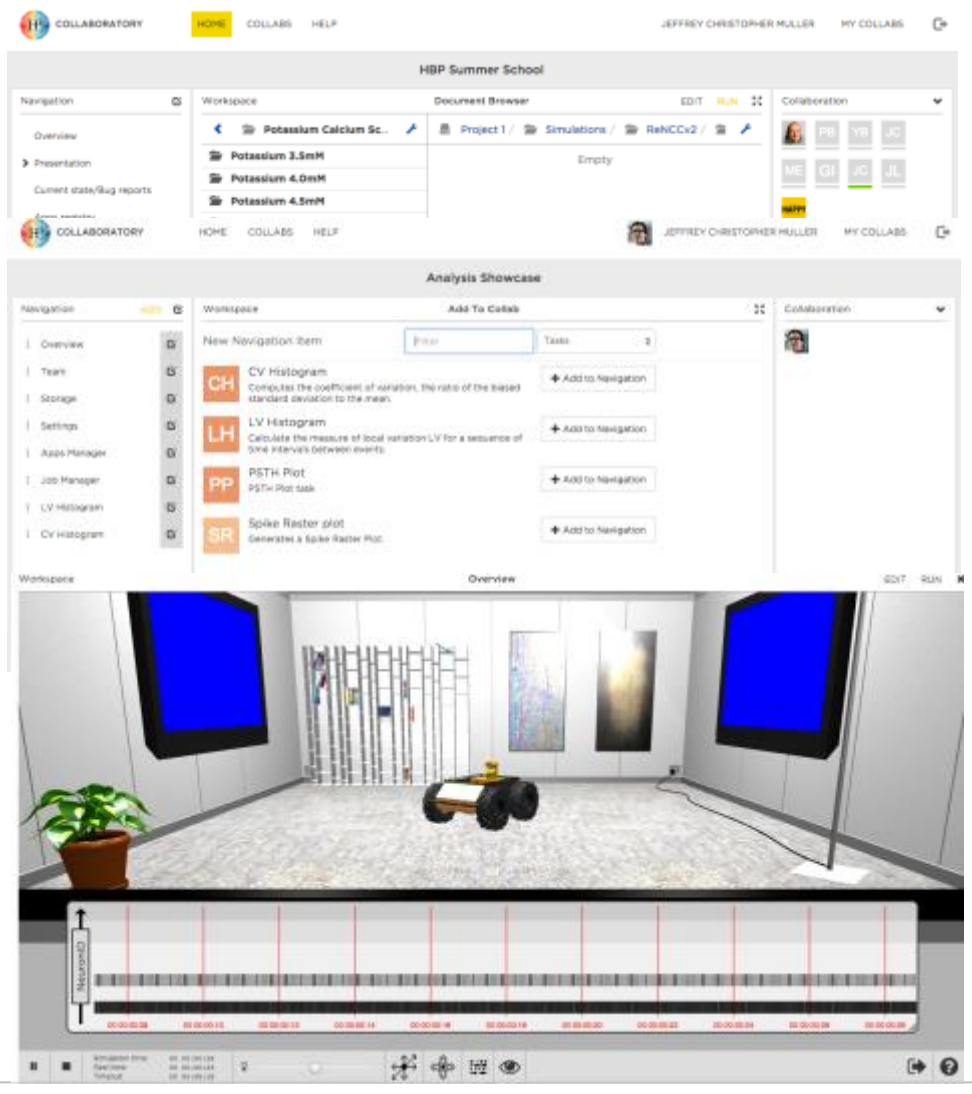
- Next-generation chips: New prototype chips of the neuromorphic systems have been developed for both hardware systems. The prototypes represent key ingredients for the realisation of the detailed Neuromorphic Platform roadmap that defines the technical specifications of the Platform until 2023.

SP10 Neurorobotics Platform

- Robot and body models: Several mobile robot models have been integrated and tested in our development system. In addition, a first prototype of a virtual mouse body model has been developed.

Collaboratory

A web-based Collaboratory for global project-based scientific collaboration.



Services, standards and APIs which integrate the 6 HBP Platforms.

Over 20 Apps have already been delivered to extend Collaboratory functionality.

Over 600 users from the HBP have signed up and are using Collaboratory Apps and services.

Human Brain Project

A partnership between the EC and the MS

EC

500 M€

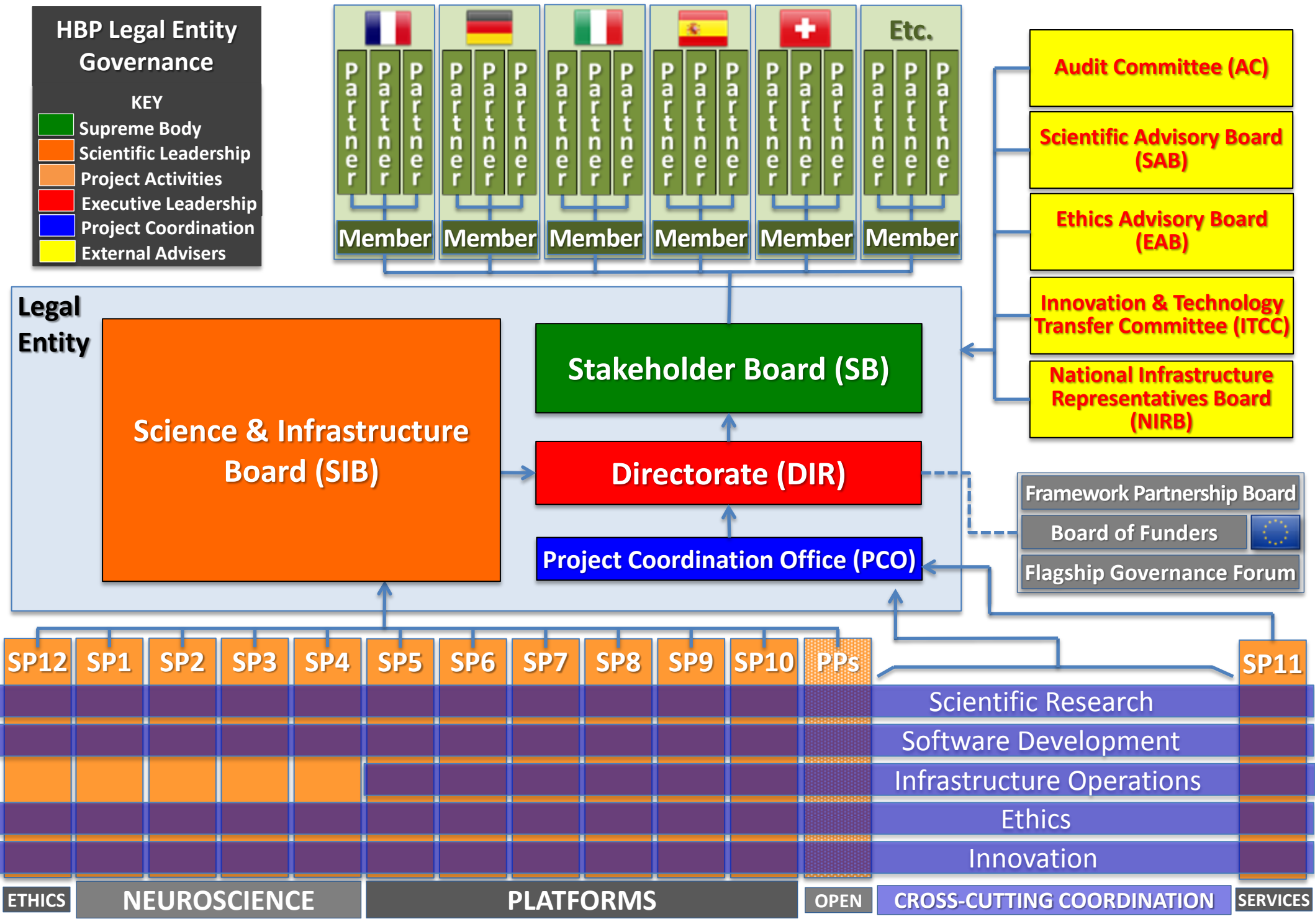
+

Partners

500 M€

= **1 billion €**

Grant	Start	End	Duration (in months)	Overlap	Funding M€
FP7 ramp-up	01.10.2013	30.09.2016	36	N/A	54
SGA 1	01.04.2016	31.03.2018	24	6	89
SGA 2	01.04.2018	30.09.2020	24	0	88
SGA 3	01.10.2020	30.09.2023	36	0	150
SGA 4	01.10.2023	30.09.2025	24	0	100
		total duration	138	Total funding	481


HBP Legal Entity Governance
KEY
Supreme Body
Scientific Leadership
Project Activities
Executive Leadership
Project Coordination
External Advisers
Partner
Member
Etc.
Audit Committee (AC)
Scientific Advisory Board (SAB)
Ethics Advisory Board (EAB)
Innovation & Technology Transfer Committee (ITCC)
National Infrastructure Representatives Board (NIRB)
Legal Entity
Science & Infrastructure Board (SIB)
Stakeholder Board (SB)
Directorate (DIR)
Project Coordination Office (PCO)
Framework Partnership Board
Board of Funders
Flagship Governance Forum
SP12
SP1
SP2
SP3
SP4
SP5
SP6
SP7
SP8
SP9
SP10
PPs
SP11
Scientific Research
Software Development
Infrastructure Operations
Ethics
Innovation
ETHICS
NEUROSCIENCE
PLATFORMS
OPEN
CROSS-CUTTING COORDINATION
SERVICES

Human Brain Project

How can you engage on a national level?

Analysis which National research and innovation objectives the HBP infrastructure or its development can support (today – in 2 years – in 5 years – beyond) (current and future user perspective)

Assess strategic interest of the National research and innovation system in tailored access to HBP infrastructure and development community (establish national access node, designated institution)

How can National funding programs or schemes support access of country's to the growing HBP family of partnering projects (multi-disciplinary user communities, strategic data, …) – FLAG ERA interface

Provide for funding of National partners or infrastructure contributions (node hours, for example) in National research strategy, launch National Programs.

Establish National Innovation Hubs (demand side measures, industry benefit, science-to-market strategies focused on local ecosystems.

Help creating national users community.

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