Human Brain Project

Co-funded by
the European Union

HBP Flagship state of play

Andreas Mortensen, Thomas Lippert

Brussels, 13.06.2018

The Human Brain Project

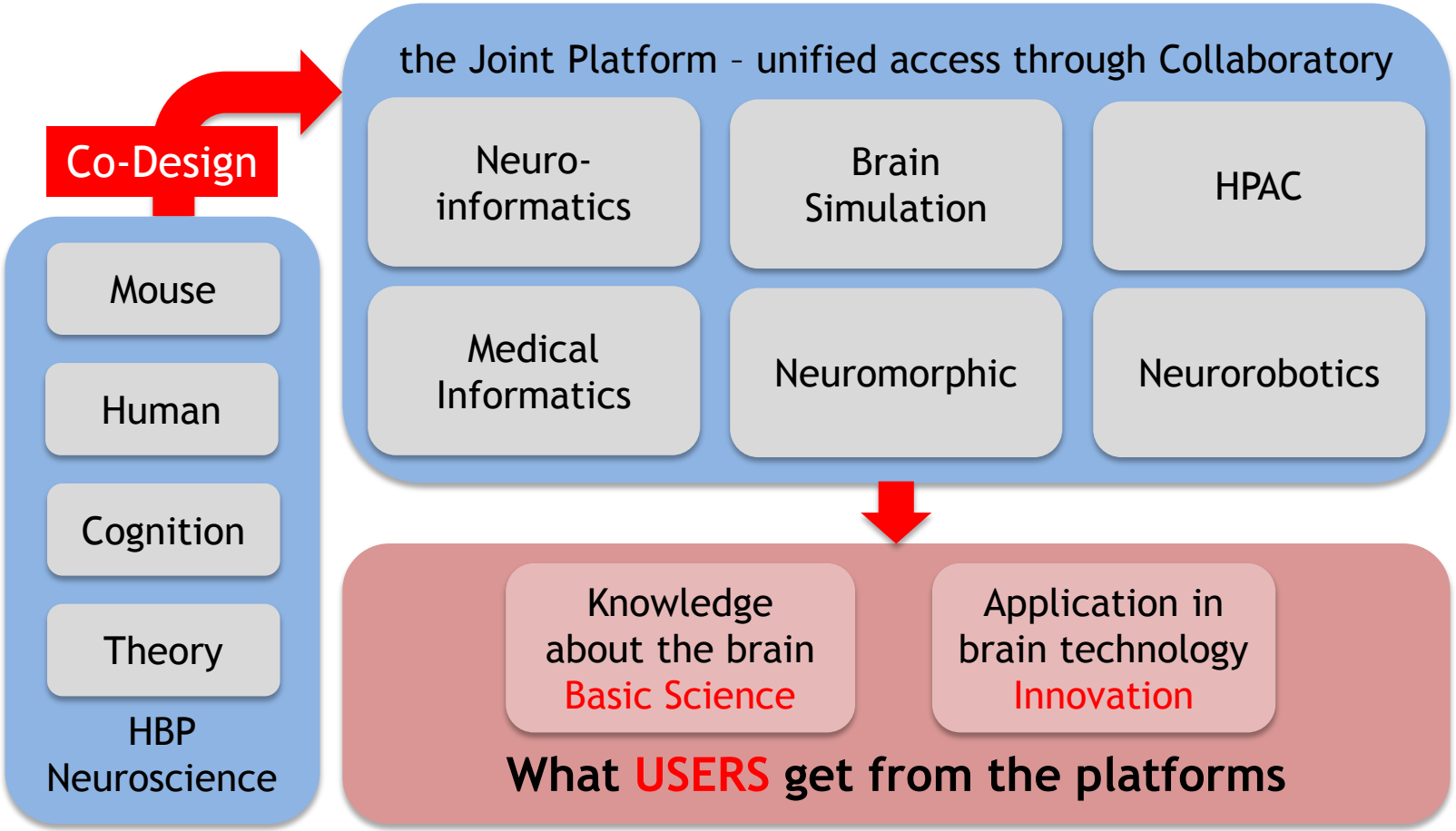
Mission

- Understanding the human brain is one of the greatest challenges facing 21st century science
- If we can rise to it, we can gain profound insights into what makes us human, build revolutionary computing technologies and develop new treatments for brain disorders
- Today, for the first time, modern ICT has brought these goals within reach

Co-funded by the European Union

The idea of HBP

from Science to Joint Infrastructures to Science and Innovation



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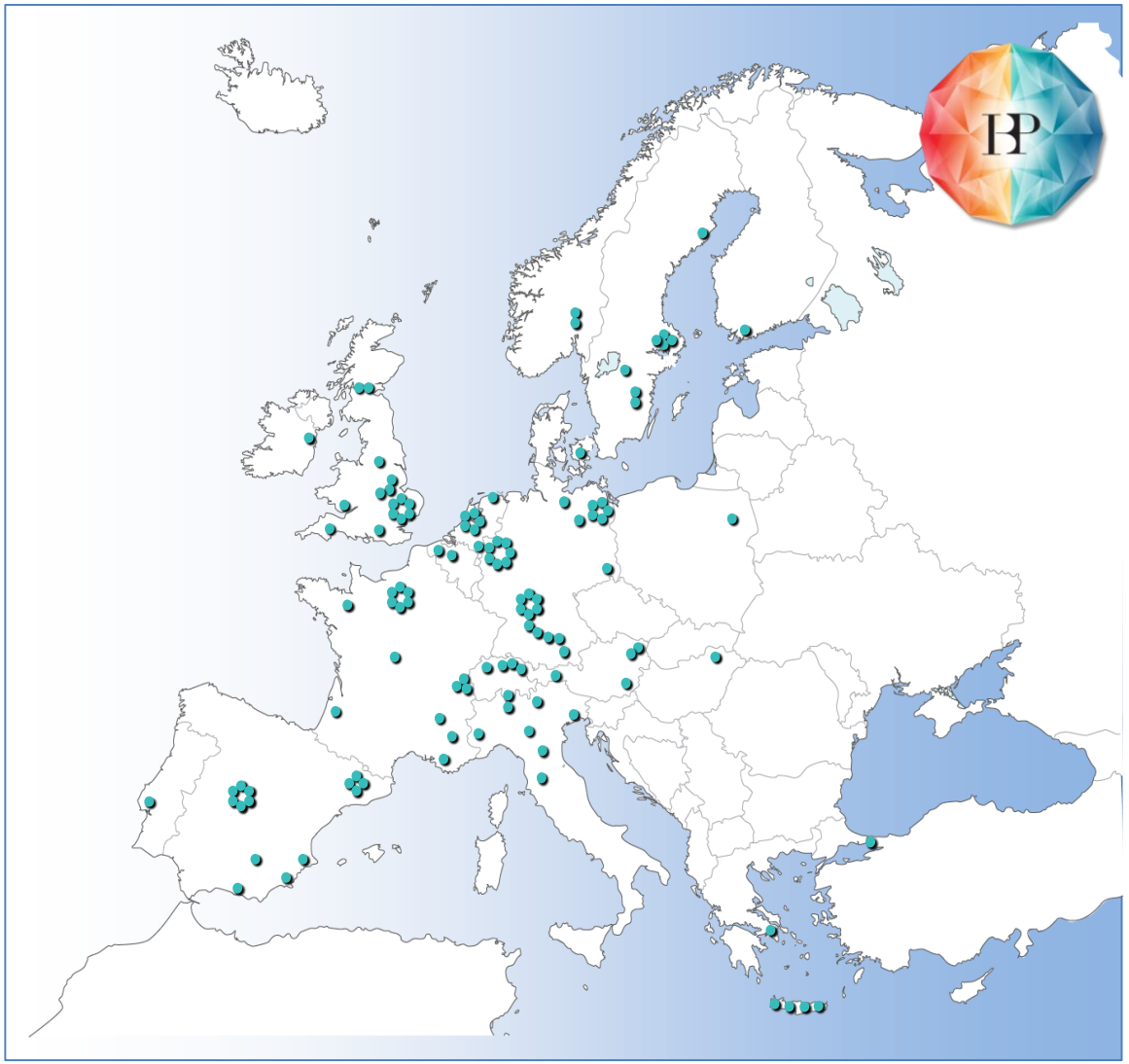
HBP at a glance (i)

- 116 partners institutions
- 19 countries, 9 associated countries
- More than 600 researchers involved



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Contribution of EU countries to HBP

=> coordinator, neuroscience, informatics, simulation, medicine, computing, robotics

EPFL, ETHZ, UZH, CHUV, UBERN, UNIGE, UNIBAS, ISB

=> neuroscience, informatics, simulation, computing, medicine, robotics

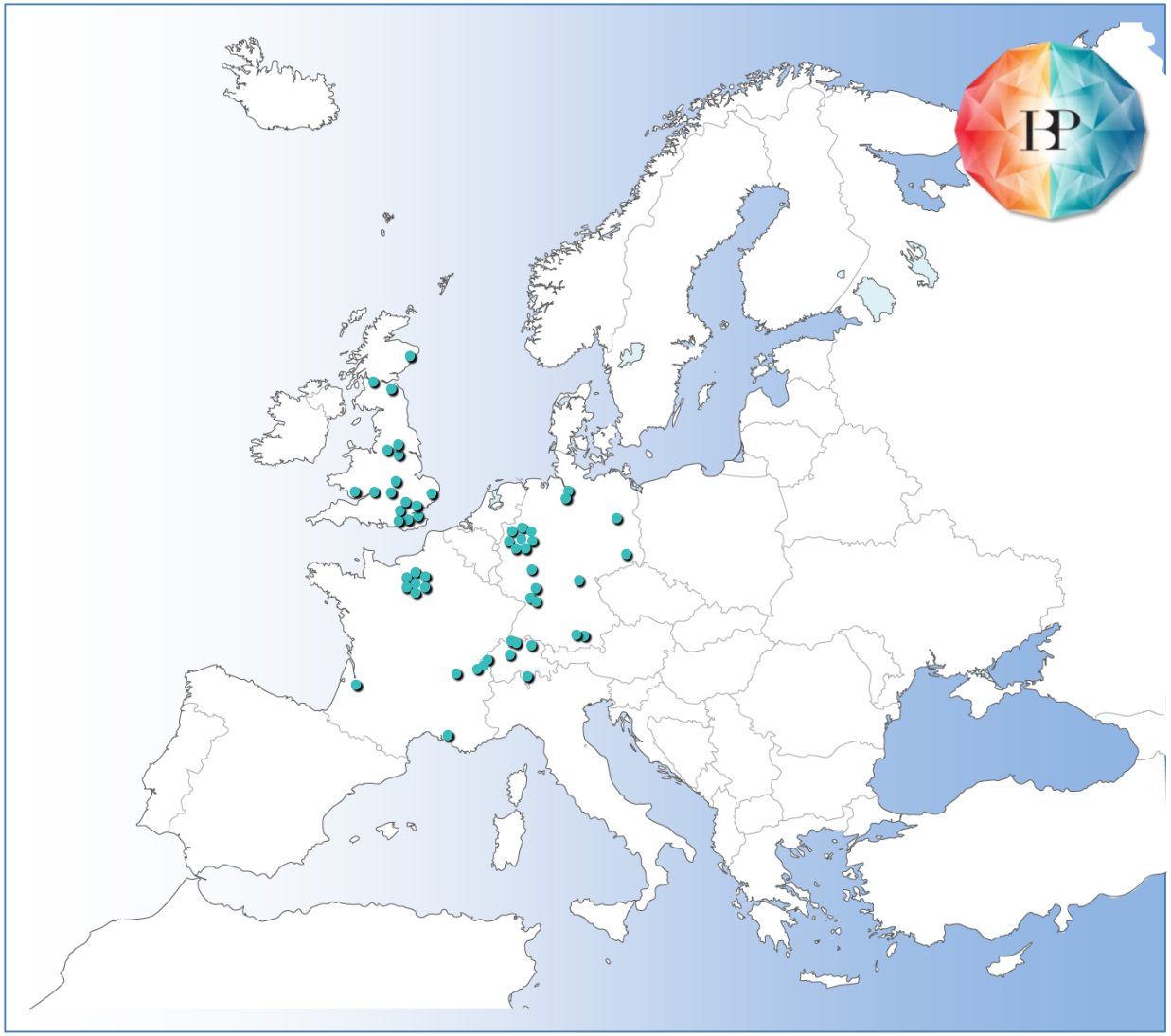
BAUW, BUW, JUELICH, FORTISS, FG, UDUS, HITS, UFRA, KIT, RWTH, UHEI, FZI, TUD, TUM, UNIBI, UKAACHEN, UKE, TUDA, UHAM, UBER, DZNE

=> neuroscience, informatics, simulation, medicine, computing, ethics

CF, DMU, ICL, KCL, UOXF, UABER, UEDIN, UMAN, UCL, UGLA, USFD, UWE, SURREY, ULEEDS, UoS, MU, HERTS

=> neuroscience, informatics, simulation, computing, medicine, ethics

CNRS, CEA, ENS, ICM, INRIA, IP, AMU, UBO, UPMC, UCBL



Contribution of EU countries to HBP

=> neuroscience, simulation, computing, robotics

CNR, CINECA, LENS, SSSA, UNIPV, INFN, UMIL, ISS, POLITO, EBRI, SNS

=> neuroscience, computing, informatics, robotics

BSC, UAM, UCLM, UGR, UPM, URJC, UB, UPF, IDIBAPS, IBEC

=> neuroscience, informatics

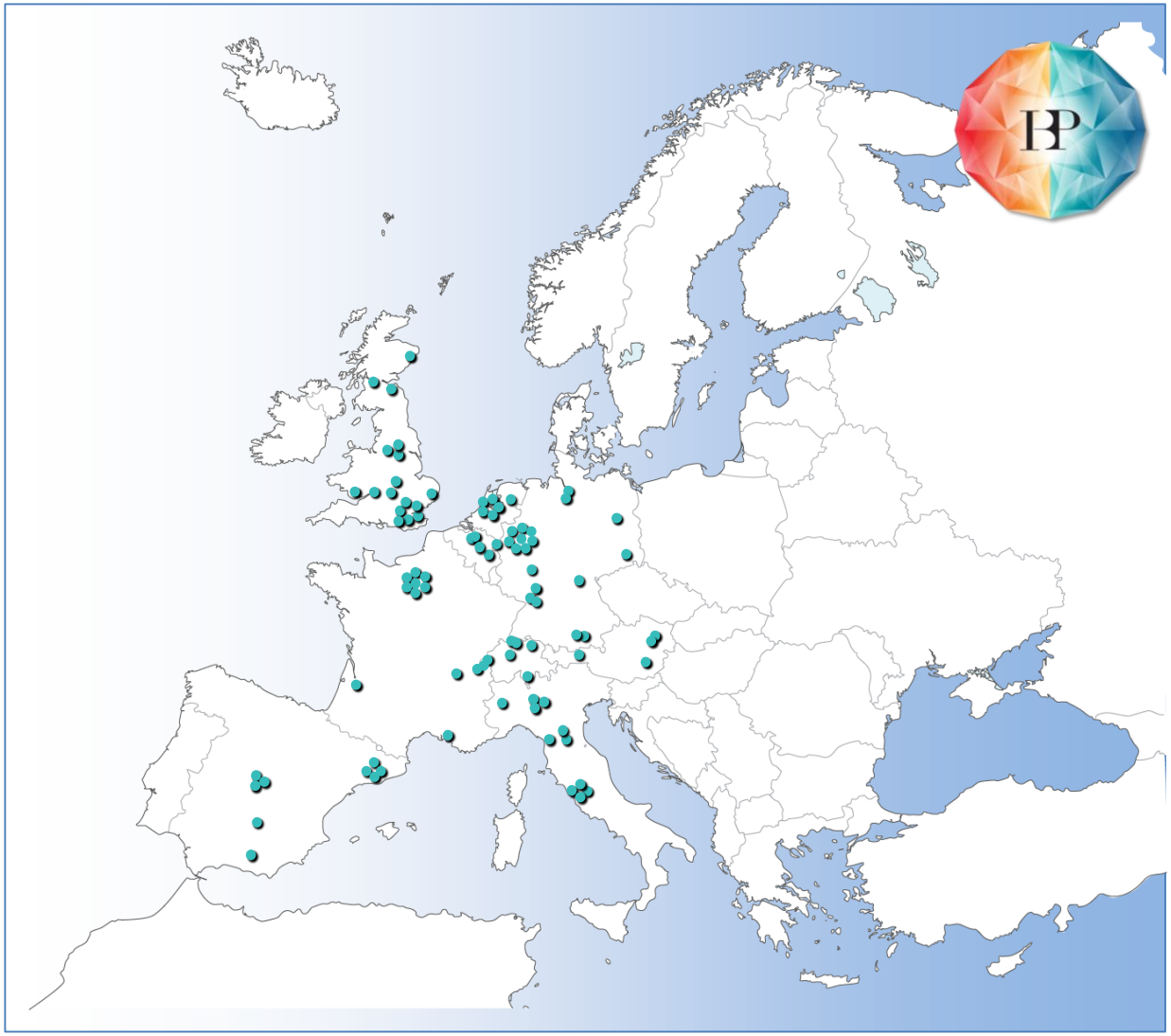
LUMC, CWI, SKU, KNAW, UvA, VU, UM

=> neuroscience, robotics

UA, ULG, UGENT, KUL

=> education, neuroscience, computing

IST, MUI, OFAI, TUGRAZ



Contribution of EU countries to HBP

=> neuroscience, informatics, simulation, computing, robotics, ethics

KI, KTH, LNU, UU

=> neuroscience, informatics, computing, ethics

NMBU, UIO

=> neuroscience, robotics

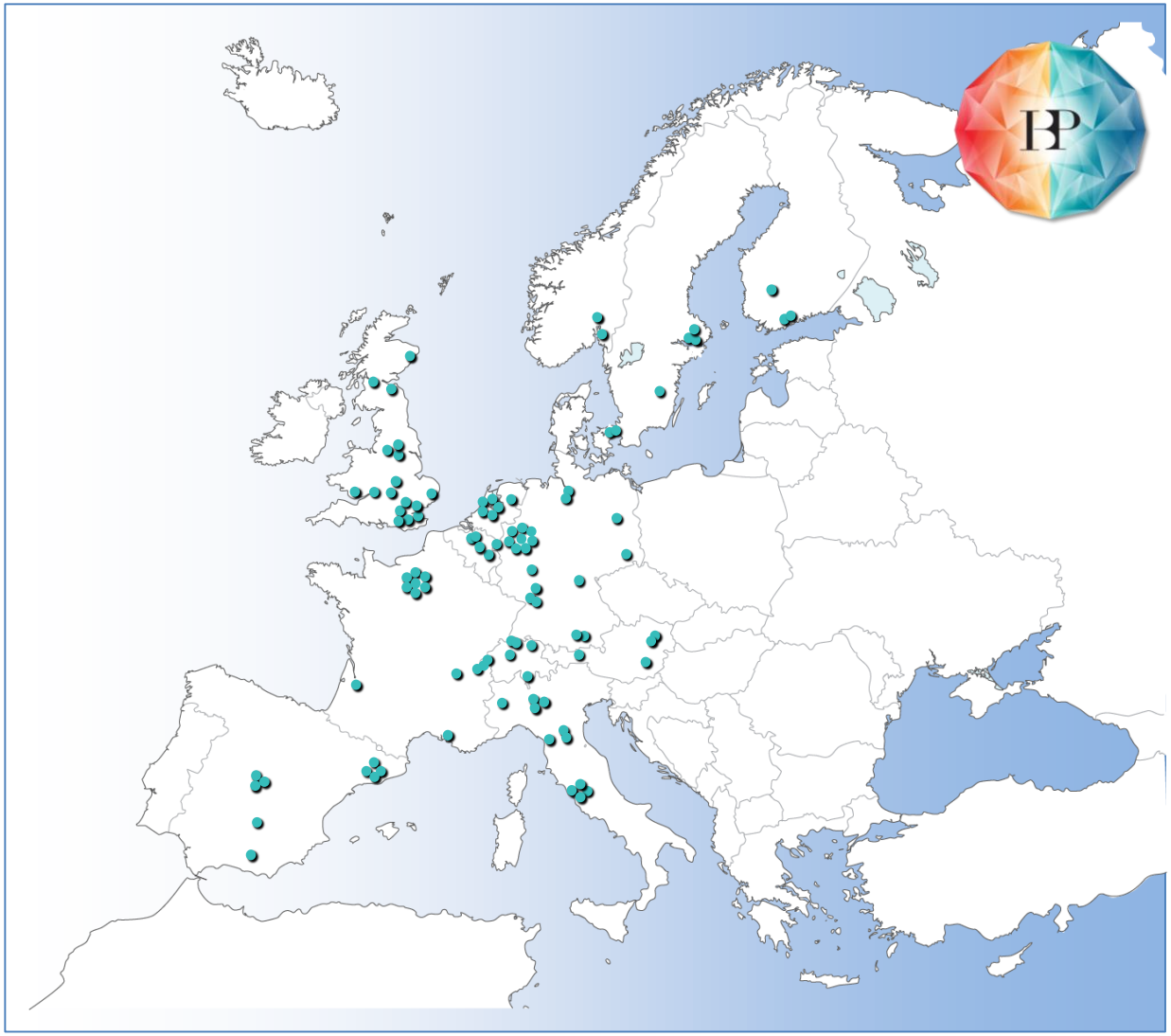
AALTO, UH, TUT

=> medicine, robotics, ethics

DTU, FT

=> neuroscience, simulation, medicine

BSMJ, TAU, HUJI, WEIZMANN



Contribution of EU countries to HBP

=> neuroscience, simulation

UoD, IEM HAS

=> neuroscience

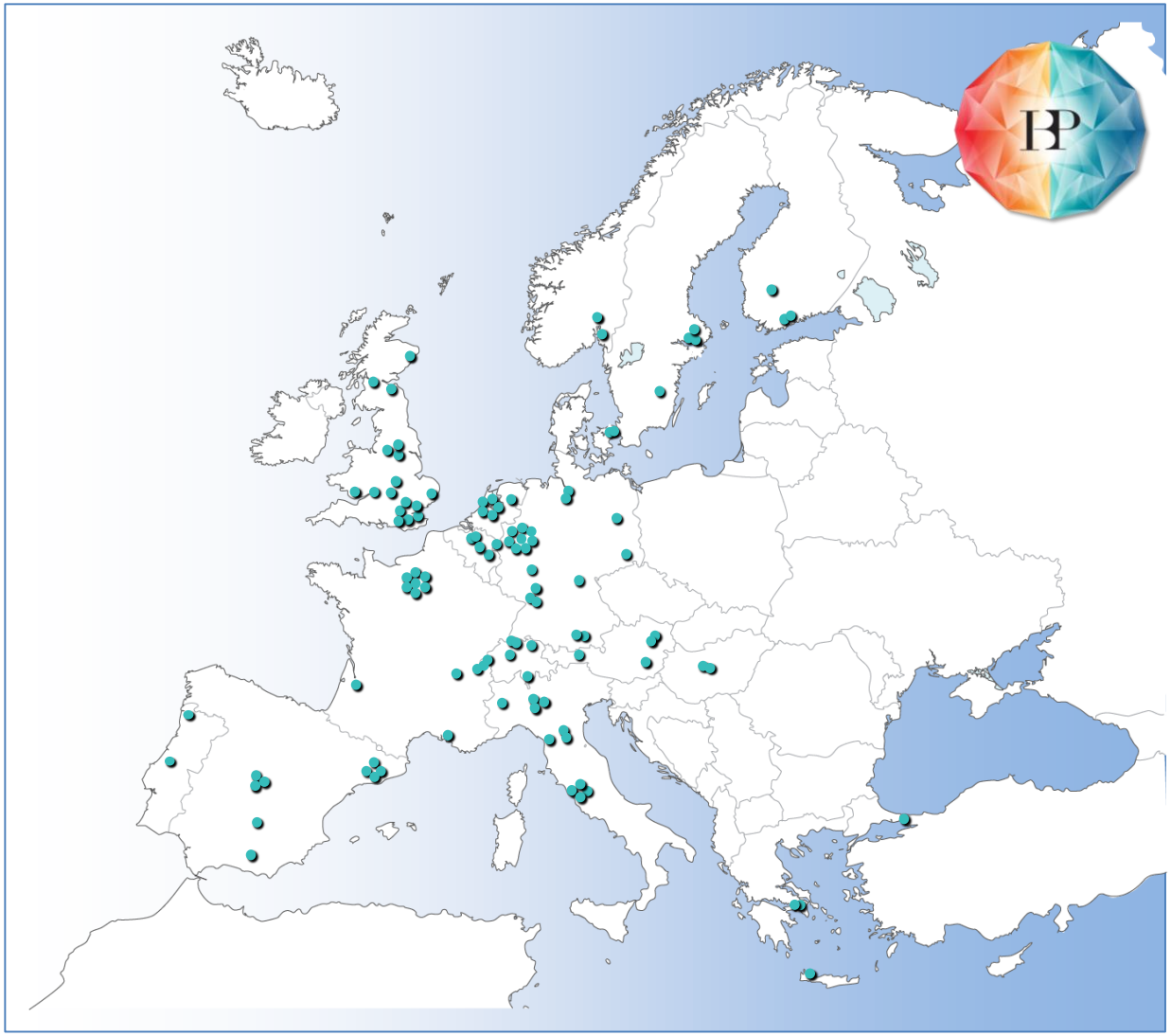
FCHAMP, UMINHO

=> medicine

AUEB, UoA, TUC

=> computing

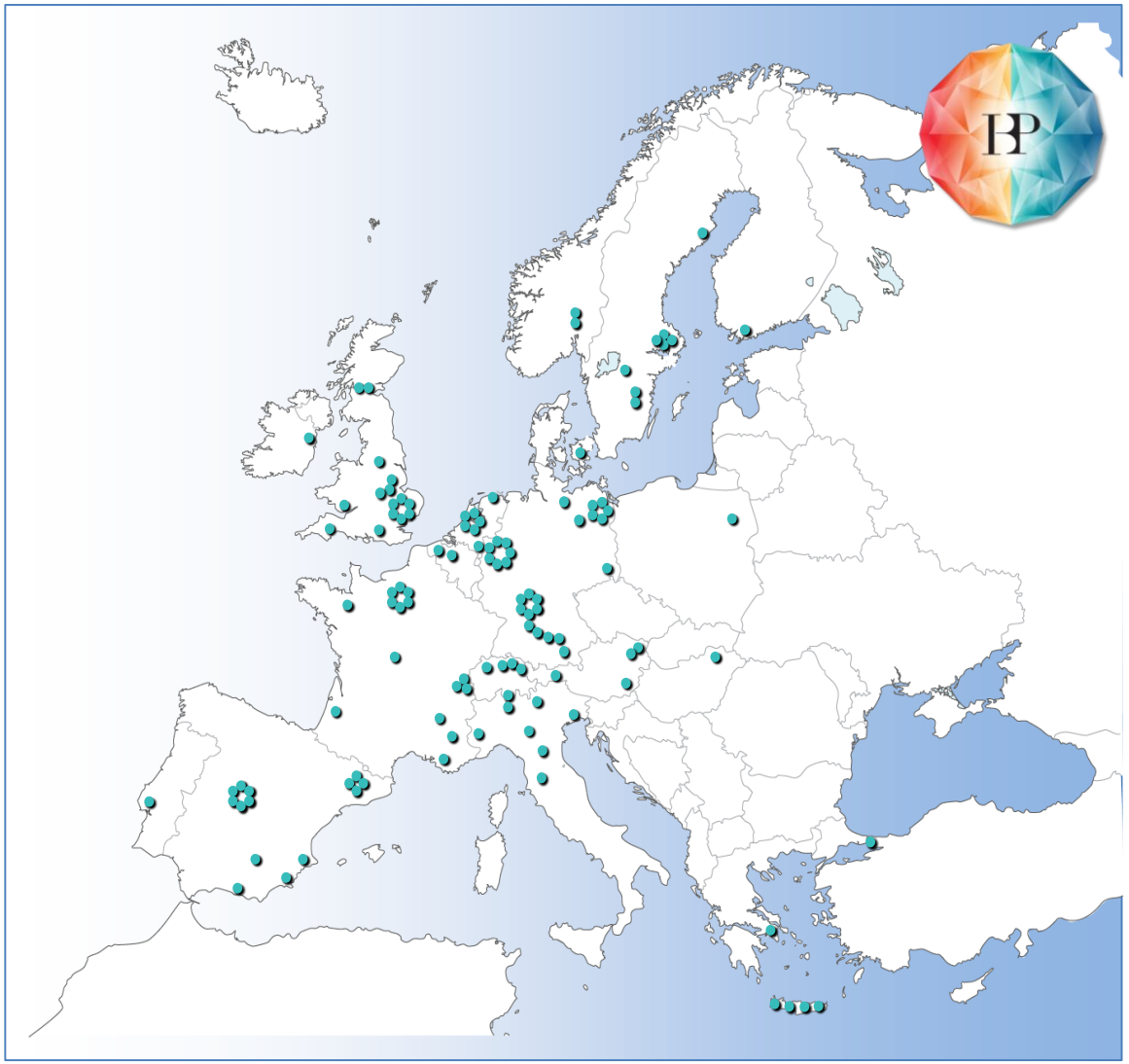
SU



Co-funded by the European Union

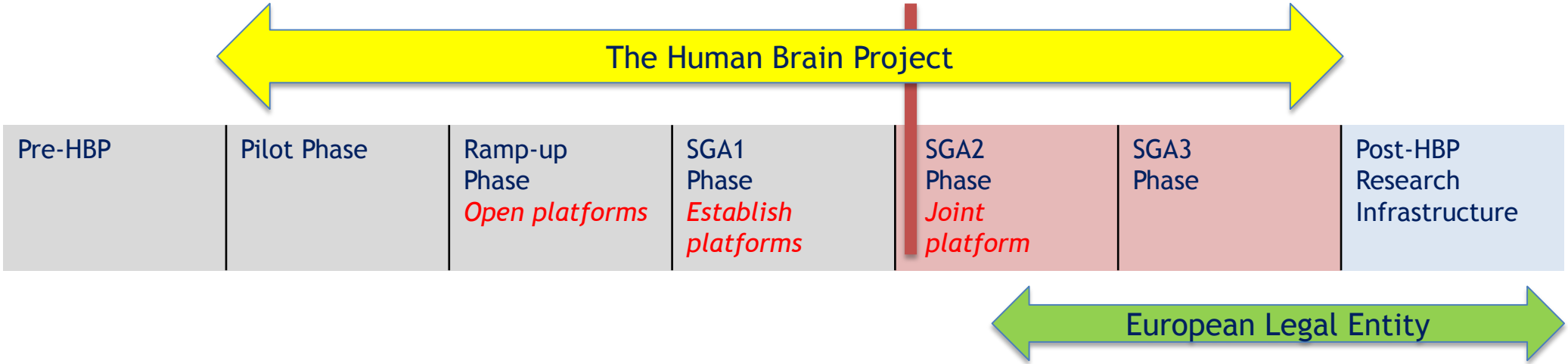
HBP at a glance (ii)

- 10-year, EUR 1 Billion Research Roadmap
- (50% Core Project, 50% Partnering Projects)
- 89 M Euros (Core Project, SGA1, 2016-2018)
- 406 M Euros estimated EU funding 2013-2023



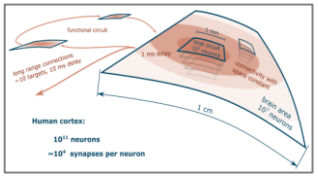
HBP at a glance (iii)

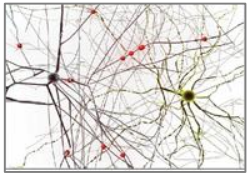
- Organized in 12 Subprojects
- 6 Co-Design Projects (CDPs) linking the Subprojects
- 6 Platforms (released in March 2016)



Co-funded by the European Union

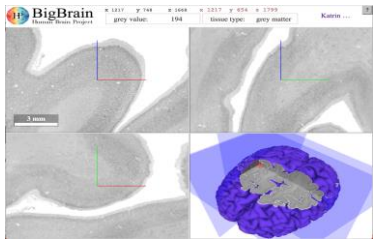
Decoding the multi-level brain organisation

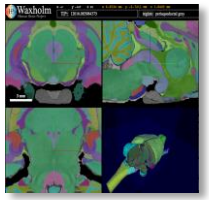


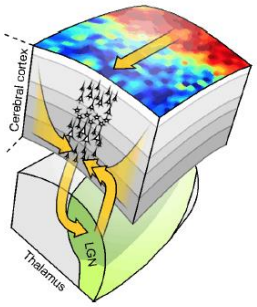


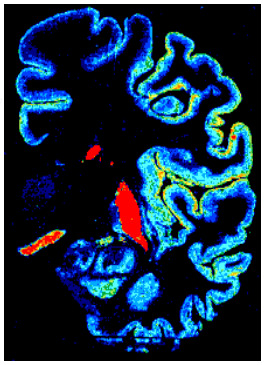
RESEARCH INFRASTRUCTURE

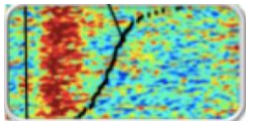
MEDICAL & NEUROINFORMATICS. SIMULATION, ATLAS, ROBOTICS

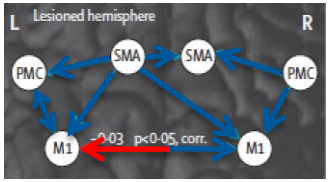


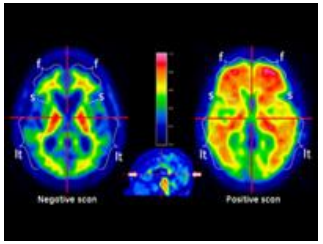


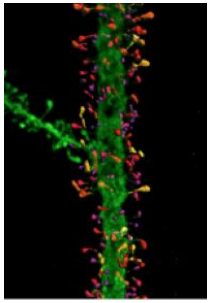


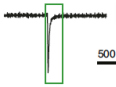


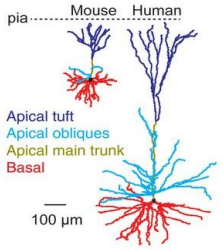


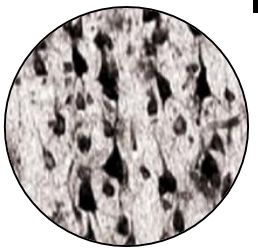


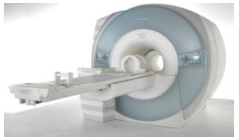


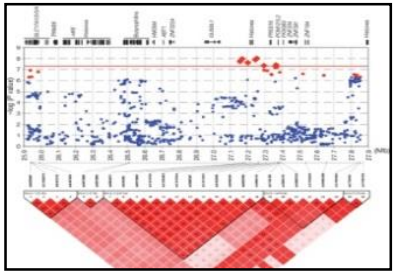


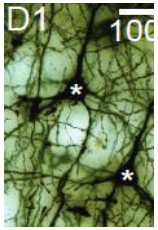


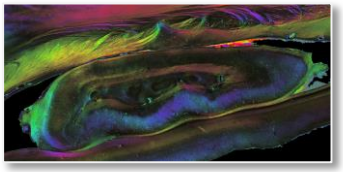


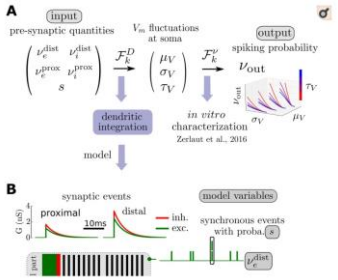


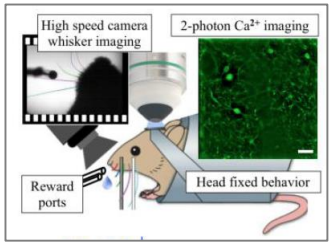












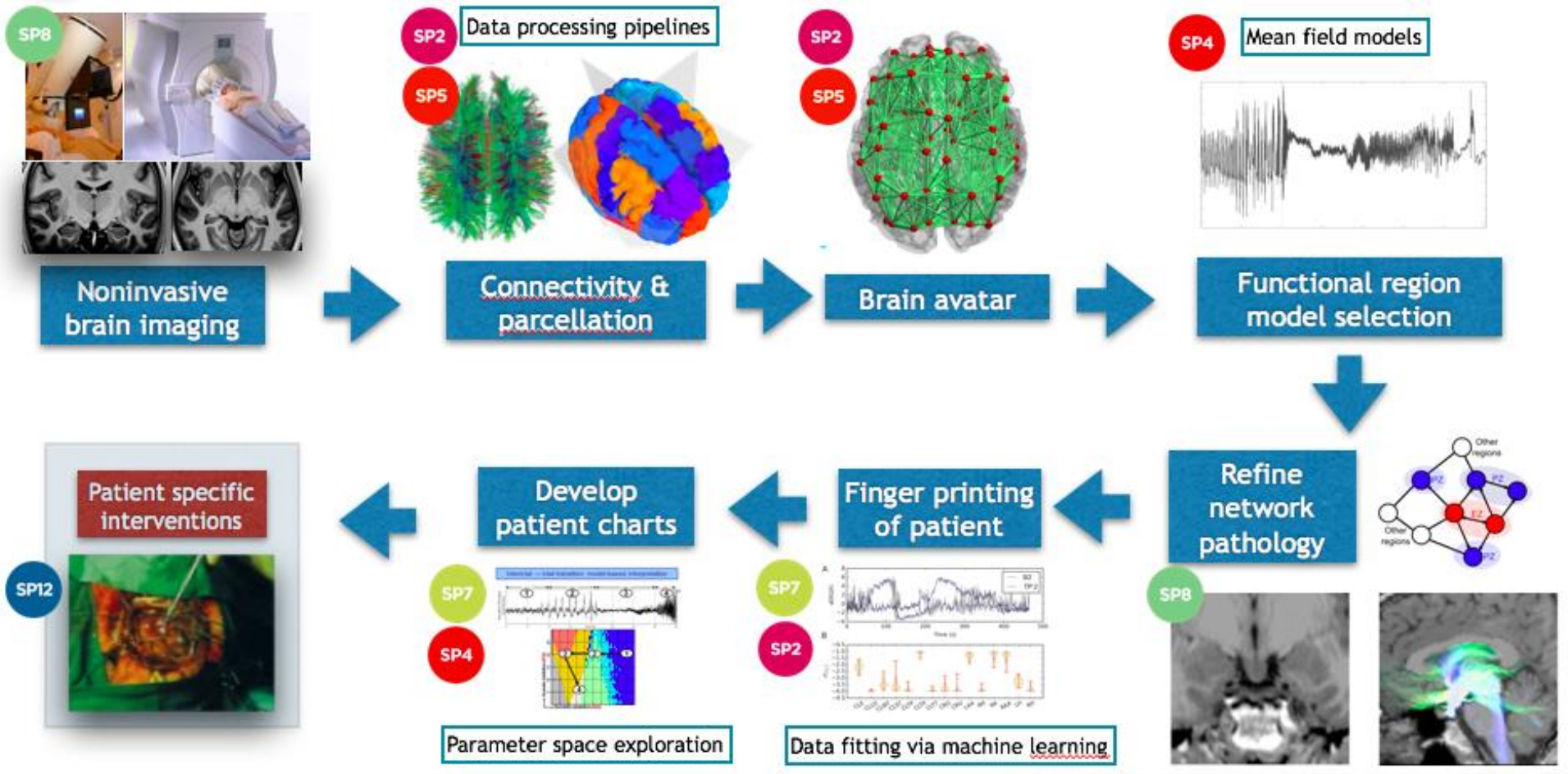
ETHICS & SOCIETY

NEUROSCIENCE & BRAIN MEDICINE

EXPERIMENT, THEORY, MODEL

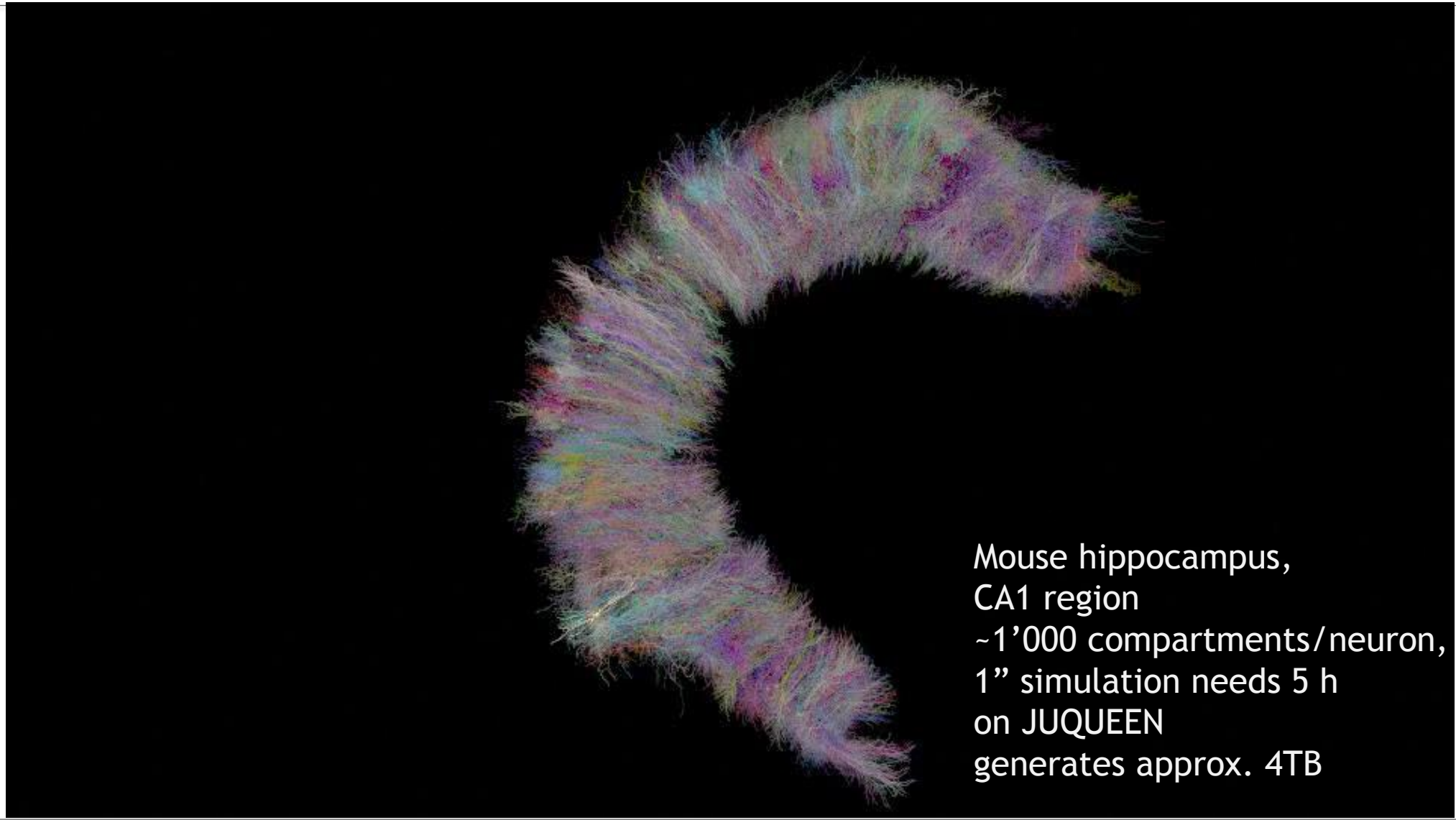
Examples of achievements –
building the personalized avatar of epileptic patients

Patient-specific large-scale brain networks to improve the treatment of epileptic patients



Jirsa et al.

Examples of achievements –
brain simulation



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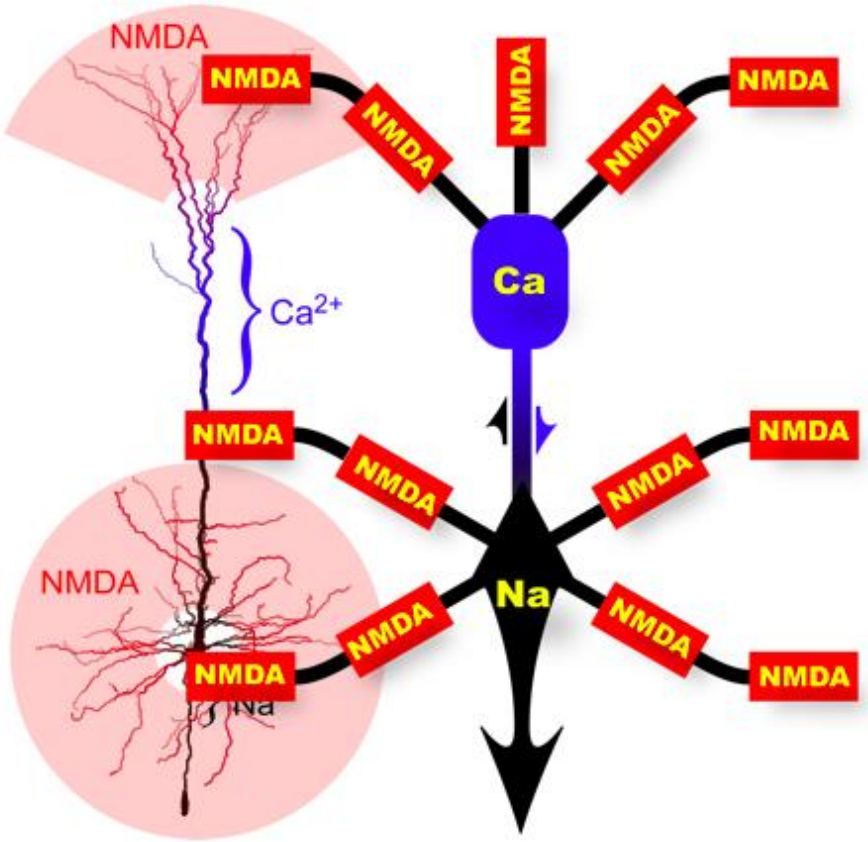
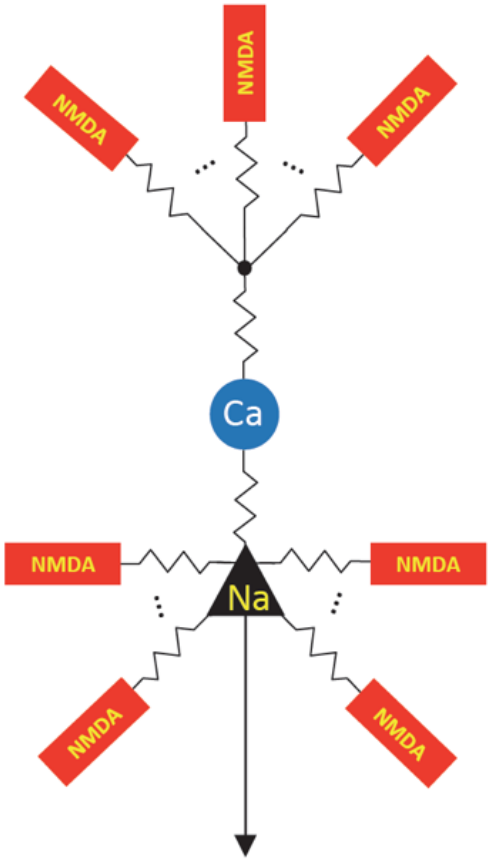
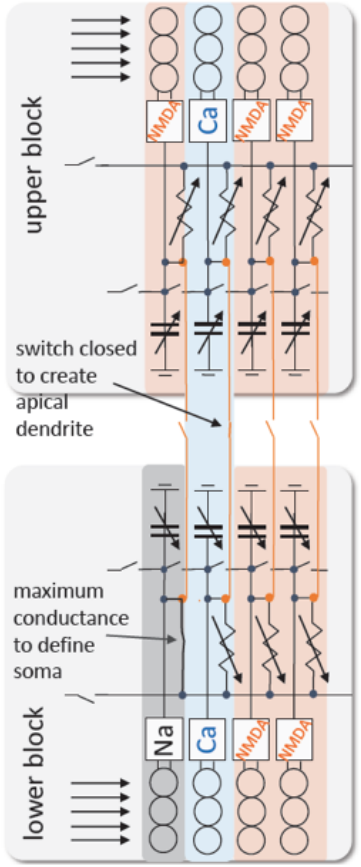
Examples of achievements –
how neuroscience drives future computing

Encapsulating the properties of pyramidal neurons



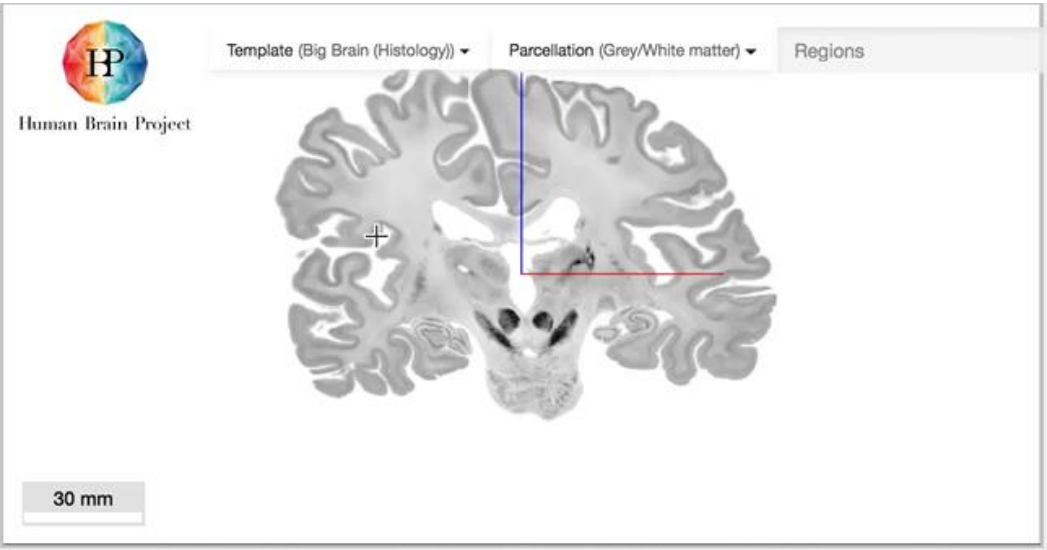


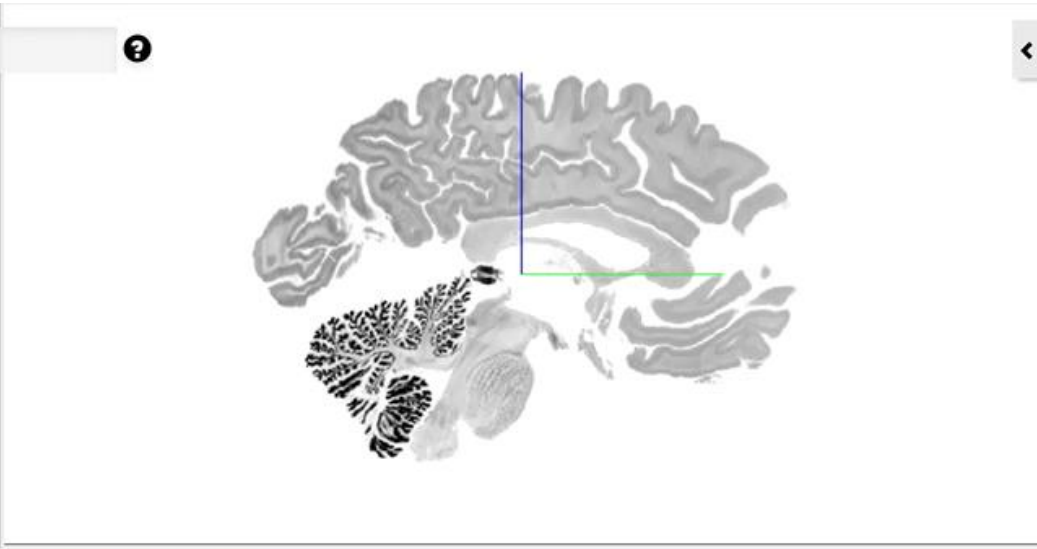


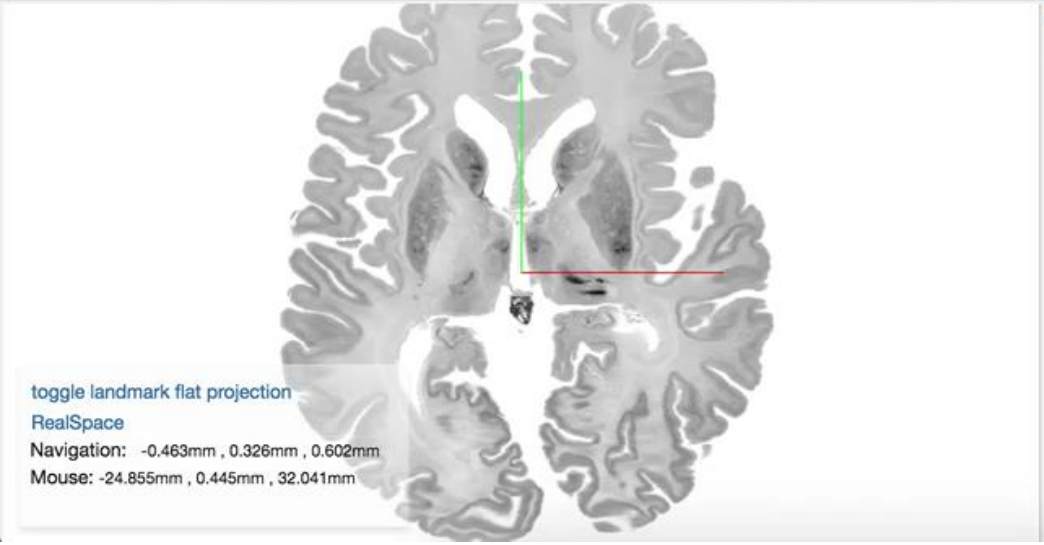
Neuromorphic installation

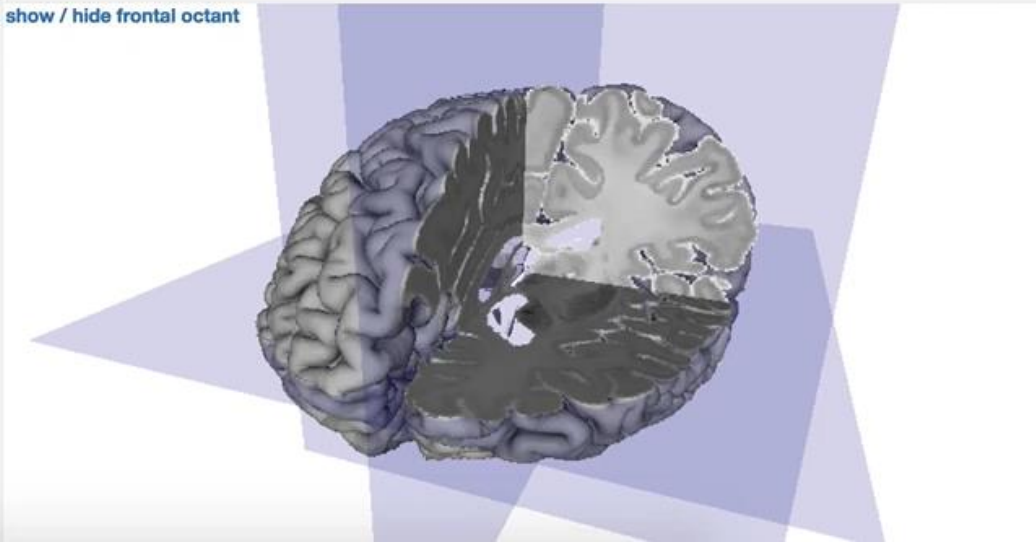
Schemmel, J., Kriener, L., Müller, P., & Meier, K. (2017, May). An accelerated analog neuromorphic hardware system emulating NMDA-and calcium-based non-linear dendrites. In *Neural Networks (IJCNN), 2017 International Joint Conference on* (pp. 2217-2226). IEEE.

Examples of achievements –
the HBP Human Brain Atlas: open multi-level data









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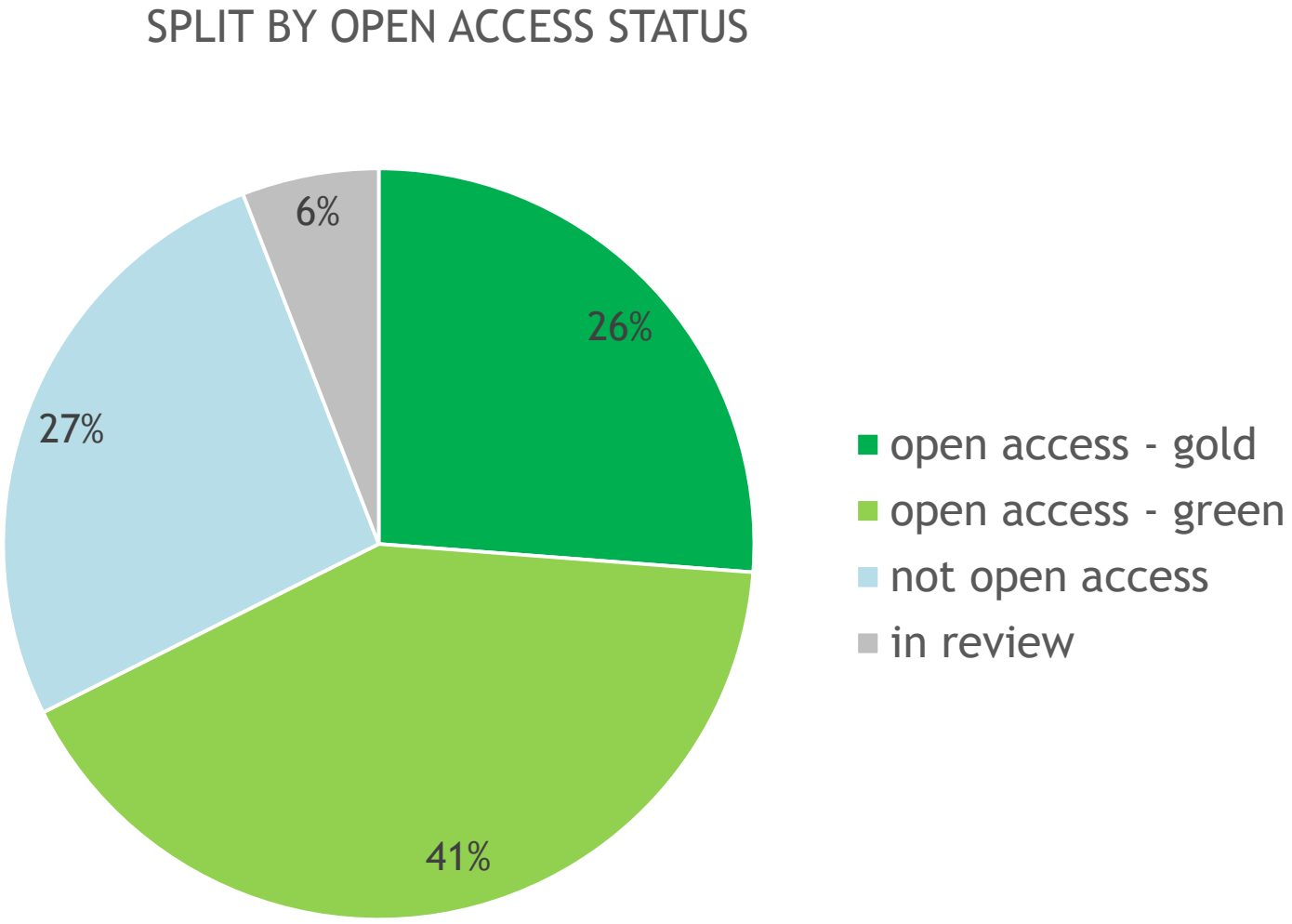
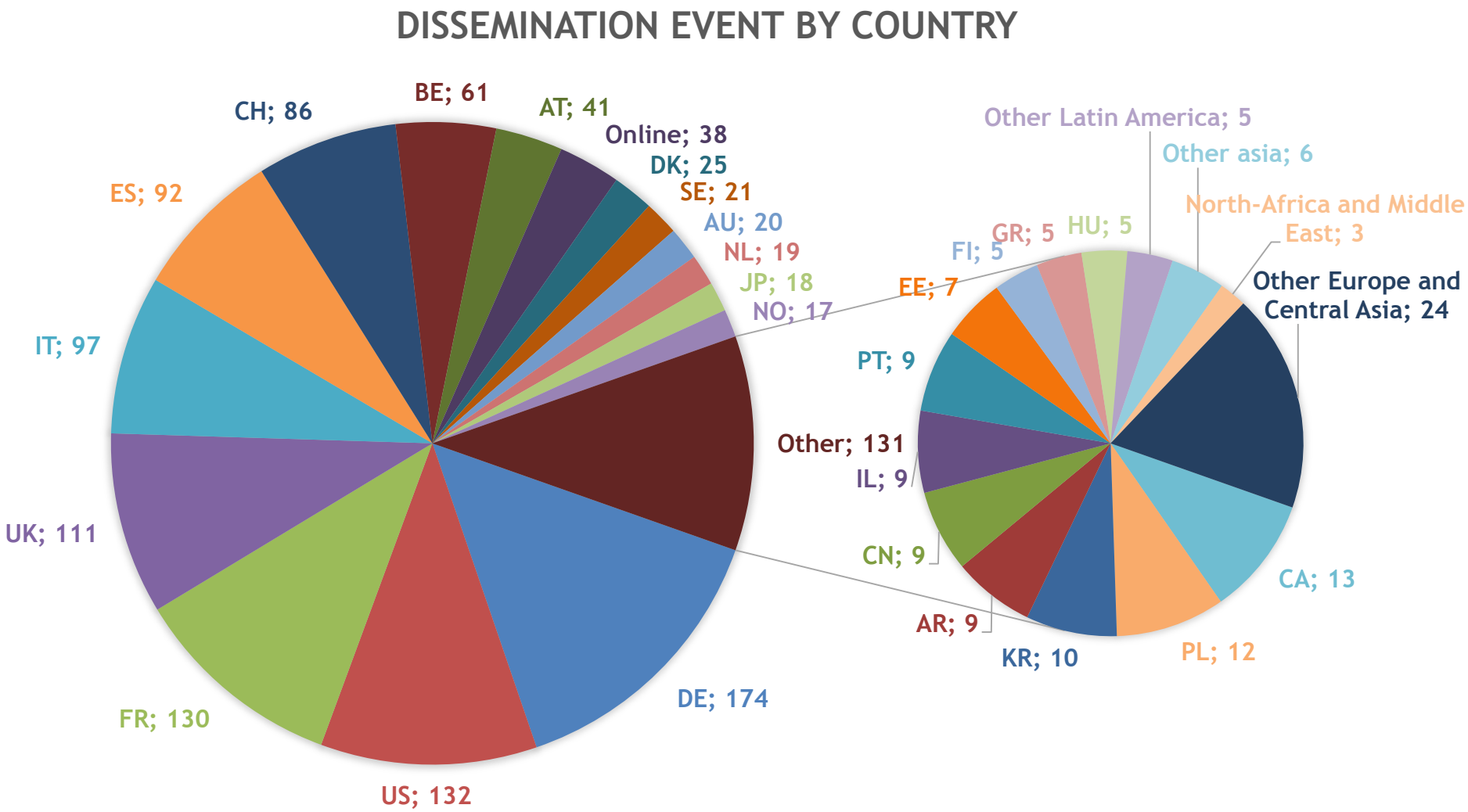
Strong commitment to Open Access

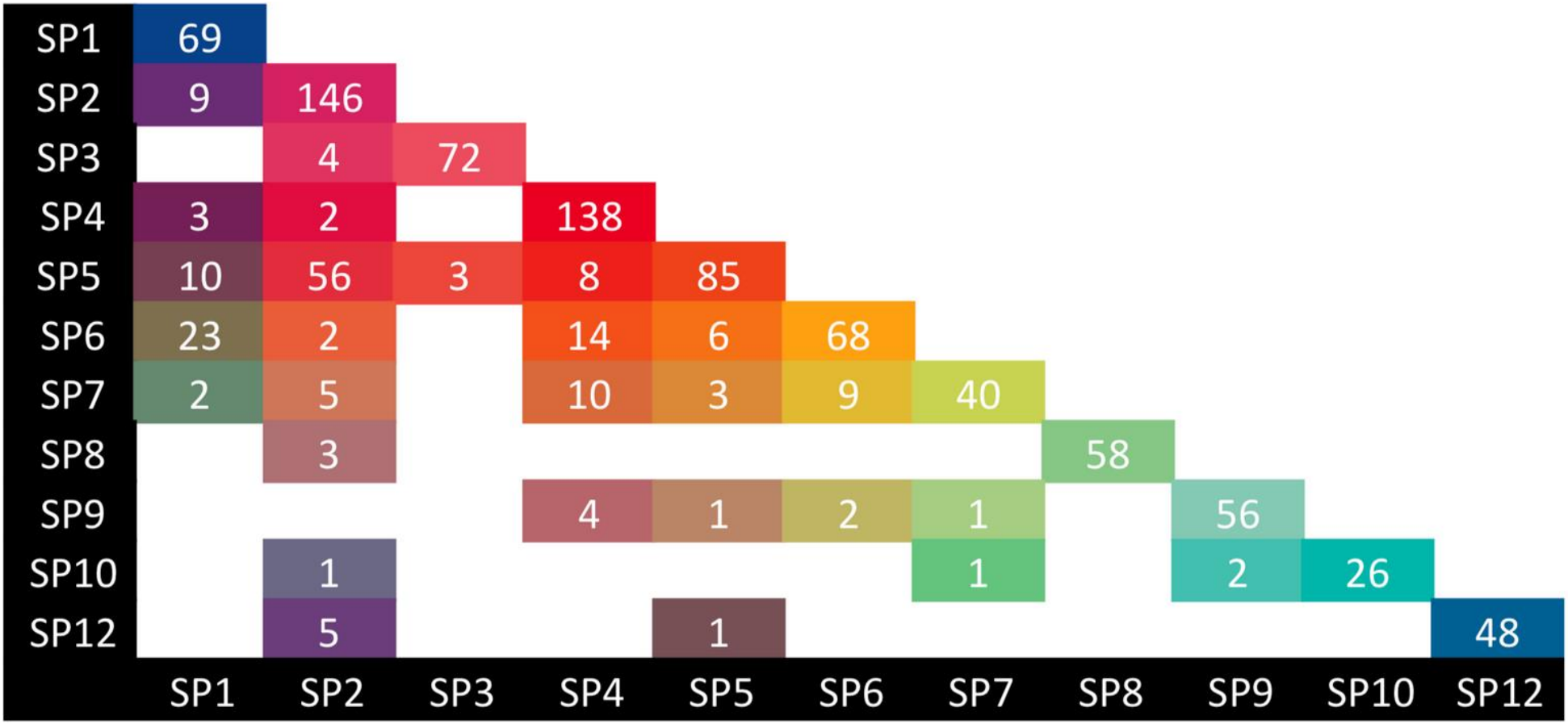
Of the 645 publications in SGA1 →



Active dissemination of HBP results globally



Sharing knowledge: cross-disciplinary publications



Growth and impact of HBP platforms

SP5

Neuroinformatics Platform
Number of files uploaded: 181387
Reference atlas: 1.97 Mio server hits, 5278 visitors (April 2018-May 2018 alone)

SP6

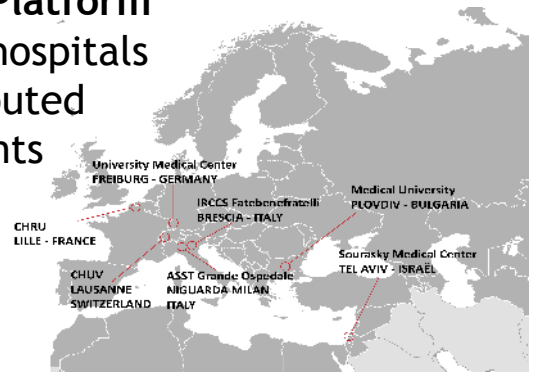
Brain Simulation Platform
- Number of page views -> 41050
- Number of collabs created by external users -> 1267

SP7

High Performance Analytics and Computing Platfrom
400 accounts on HPC and Cloud infrastructure of the HPAC Platform

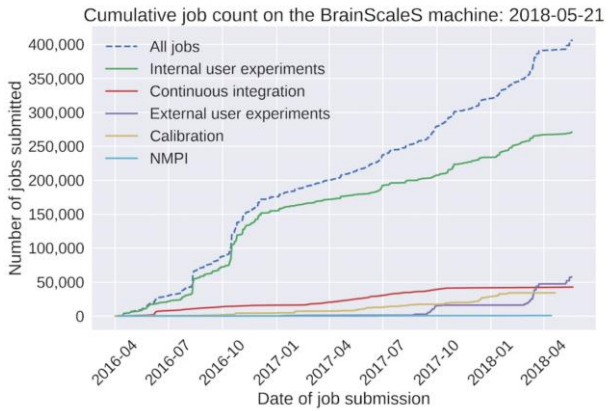
SP8

Medical Informatics Platform
- MIP installed in 7 hospitals
- 3 hospitals contributed data from 6345 patients



SP9

Neuromorphic Computing Platform



SP10

Neurorobotics Platform
285 registered users at the end of SGA1 (currently >400)
37410 views of the NRP forums (280 views per thread)
775 Twitter followers

Massive Open Online Courses (MOOC)

Massive Open Online Courses in SP6 show promise for wider dissemination of HBP Platforms

Lessons learned

- the HBP Collaboratory provides a good environment for hosting online exercises and courses
- the MOOC proved to be a great incentive for finalizing a robust, accessible set of platform tools
- MOOCs are good for wide dissemination of new yet-to-be-established models, methods and tools
- wide outreach and always available
- after initial development, can run with minimal oversight

MOOC activities in HBP

2 courses already running for Brain Simulation Platform

- 1st course launched by Blue Brain Project (BBP) for HBP in November 2017, more than 6500 registrations, 10% active learners
- 2nd course launched as a collaboration between BBP and Allen Institute

2 courses in preparation (should launch before end of 2018)

- Brain Simulation Platform: 3rd course on microcircuit exploration
- Neurorobotics Platform: 4th course

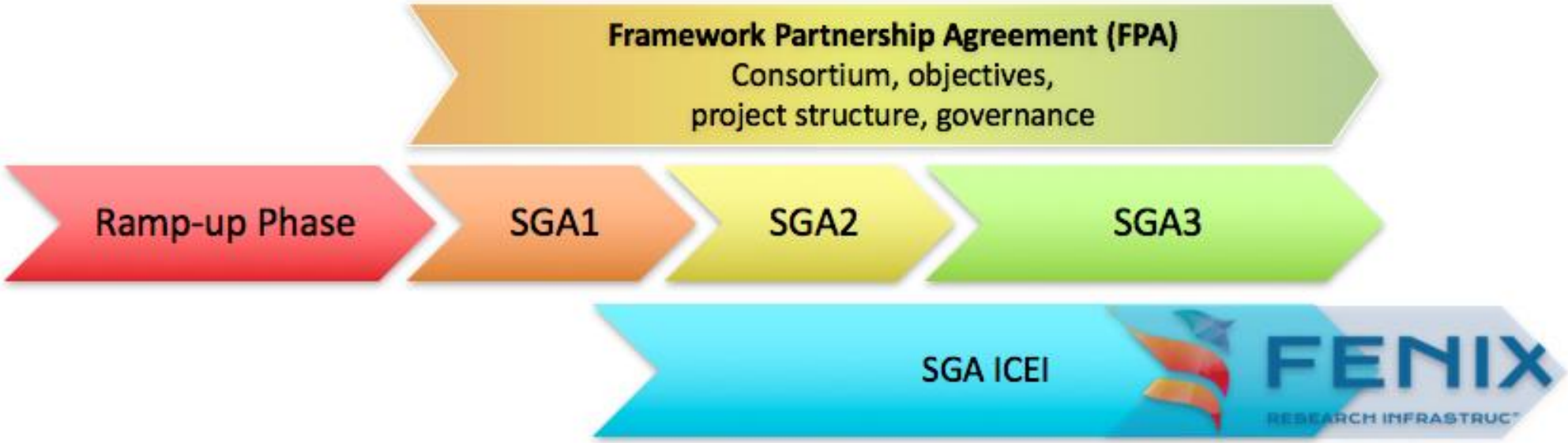
3 additional courses in early discussions:

- Collaboratory
- Neuroinformatics Platform
- Neuromorphic platform

FENIX and ICEI

FENIX and ICEI are Children of the HBP

FENIX: Federated European Network for Information eXchange
ICEI: Interactive Computing e-Infrastructure (project name)



- Oct 2013 – March 2016
- April 2016 – March 2018
- April 2018 – March 2020
- April 2020 - March 2023 (tbc)

Fenix Overview

1. Partners: BSC, CEA, CINECA, CSCS, JSC
   a. All sites are PRACE Tier-0 sites
2. The specific service targets are
   a. Interactive Computing Services
   b. Scalable Computing Services
   c. Federated Data Services
3. Resources within this Infrastructure will be managed and allocated by the HBP
   a. Site-local peer review is removed from the loop
   b. Other communities are also foreseen to manage their own allocations

FENIX goals

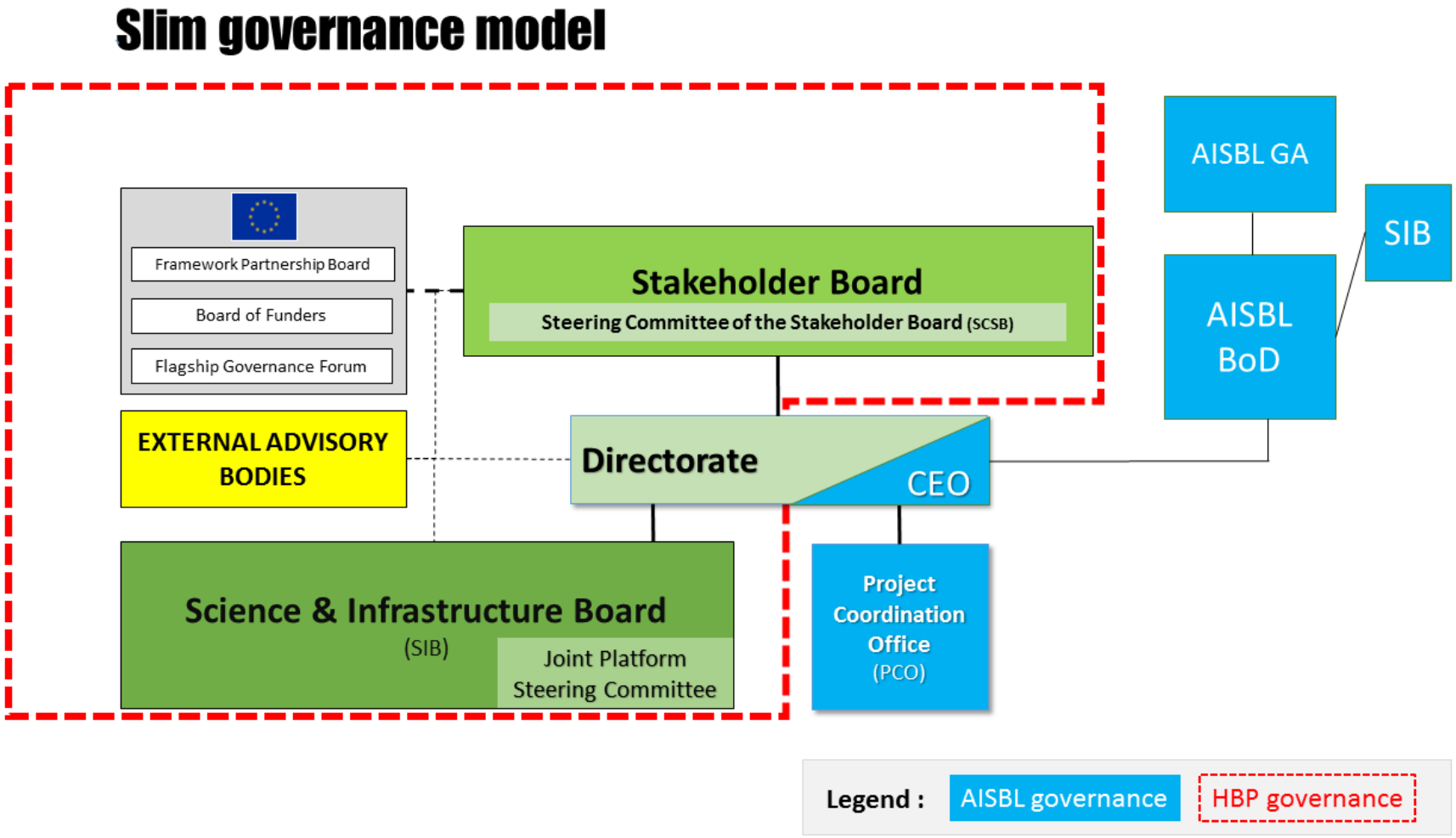
- Establish HPC and data **infrastructure services** for multiple research communities
  - Encourage communities to build community specific platforms
  - Delegate resource allocation to communities
- Develop and deploy services that facilitate **federation**
  - Based on European and national resources
- **Science community driven approach**
  - Infrastructure realisation and enhancements based on co-design approach
  - Science communities providing resources to realise infrastructure
    → HBP SGA Interactive Computing E-Infrastructure (ICEI)
  - Resource allocation managed by community
- HBP is the main driver and primary user of the Fenix RI

Co-funded by the European Union

HBP Legal Entity

- Create an association with a double objective
  - act as coordinator of HBP
  - prepare a lasting research infrastructure for brain research in Europe
- The association is an AISBL, with an office registered in Brussels and a branch in Geneva
- The founders of the AISBL will be a handful of committed institutions
- The AISBL will grow during SGA2 towards maturity under SGA3
- The AISBL has a Board of Directors (on the model of the SCSB) and a General Assembly (on the model of the SB)
- The CEO of the AISBL is also the DG of HBP
- Details are under discussion at high level (HBP-EC joint meetings)

HBP Legal Entity



HBP - the way ahead

1) Receive and digest SGA1 review (Stockholm, mid-May 2018)
2) Push the transformation towards a self-sustaining Research Infrastructure: definition, organisation, construction
3) Drive
   - open science
   - brain and neuroscience
   - in-silico medical discovery
   - personalized neuro and brain medicine
   - neuromorphic computing
   - trans/inter-disciplinarity
   - and more …

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