

## Lessons Learnt from other Initiatives:

- TEF-HEALTH
- EOSC TVB-CLOUD
- EBRAIN-HEALTH



Prof. Dr. Petra Ritter



May 17, 2023 Rome  
Deep Thinkers Meeting





BRAIN  
SIMULATION  
SECTION

Parcellations



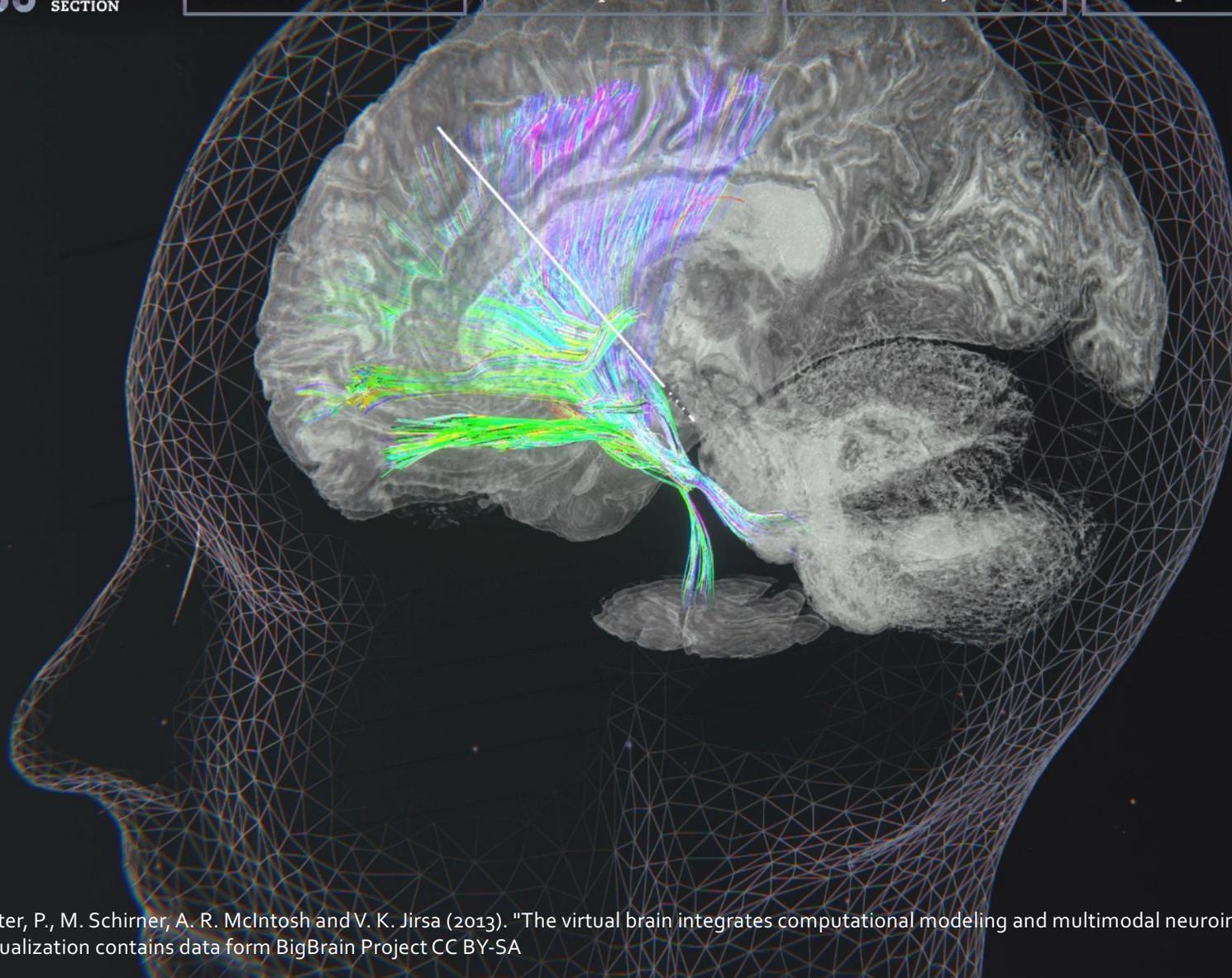
Color Maps



Brain Activity



View Options



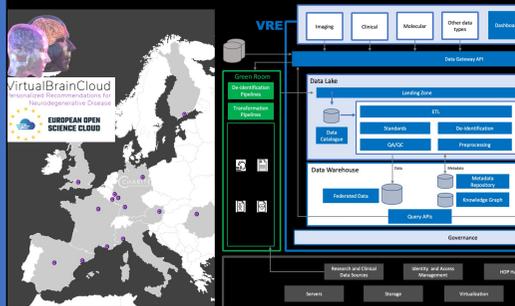
Ritter, P., M. Schirner, A. R. McIntosh and V. K. Jirsa (2013). "The virtual brain integrates computational modeling and multimodal neuroimaging." *Brain Connect* 3(2): 121-145.  
Visualization contains data form BigBrain Project CC BY-SA

# Human Digital Twin EU Projects led by Charité Berlin

eosc



Virtual Brain Cloud  
Personalized Recommendations for Neurodegenerative Disease



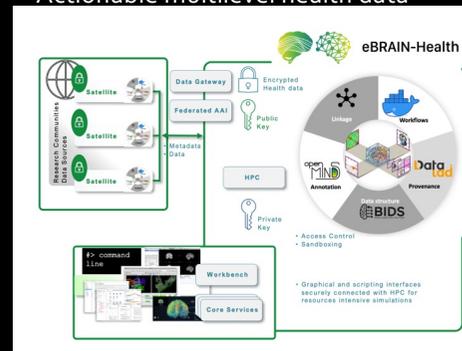
Lead: Charité, €15Mill  
2018-2023

<https://cordis.europa.eu/project/id/826421>

<https://eosc-portal.eu/about/eosc-projects?page=5>

eBRAIN-Health

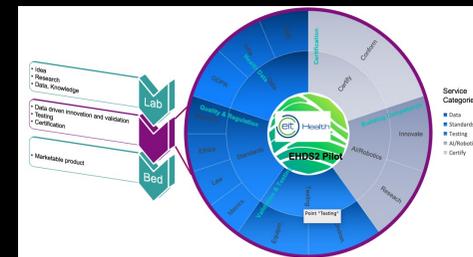
Actionable multilevel health data



Lead: Charité, €13Mil  
2022-2026

<https://cordis.europa.eu/project/id/101058516>

TEF-Health  
Testing and Experimentation Facility  
Health AI and Robotics



Lead: Charité, €60Mill  
2023-2027

[www.tefhealth.eu](http://www.tefhealth.eu)

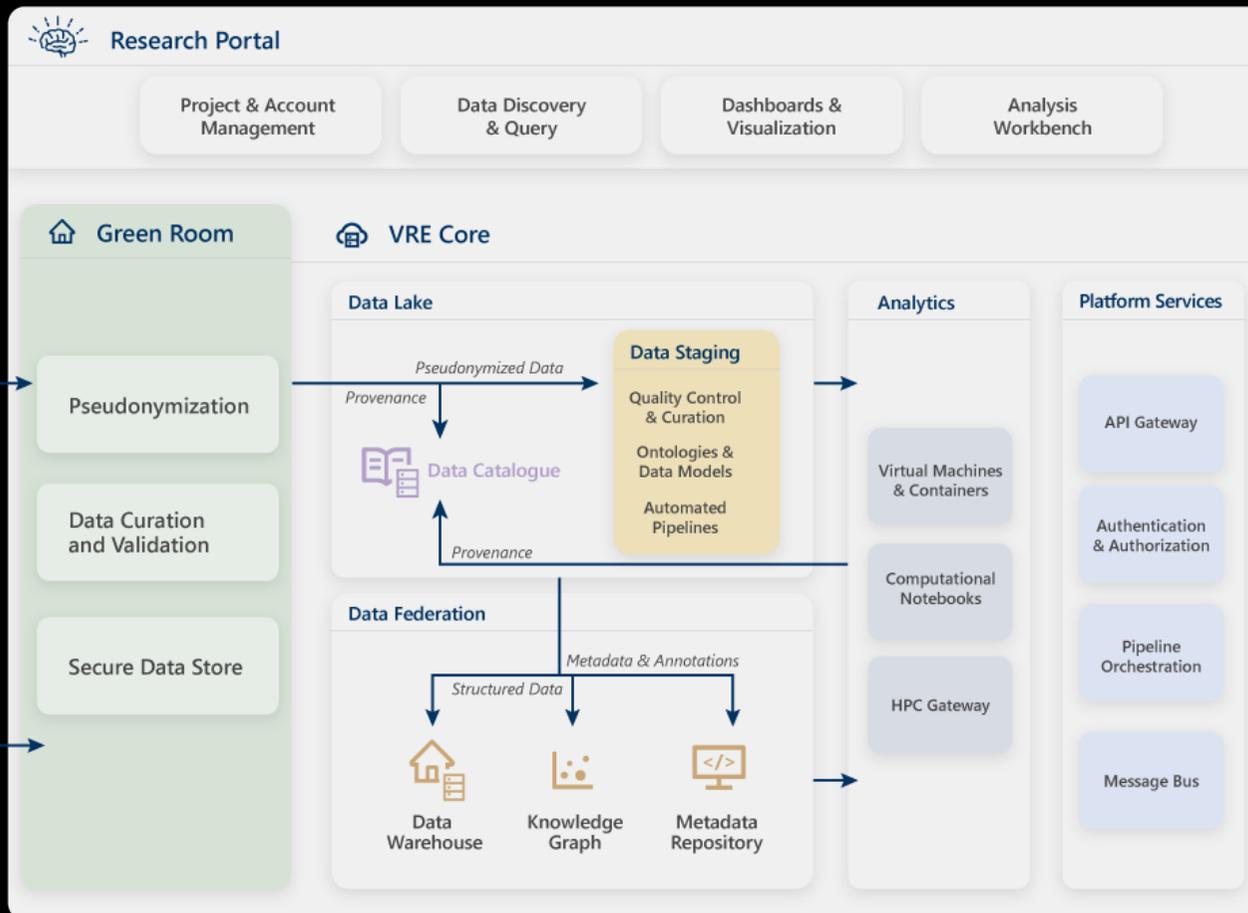
# Secure Processing Environment



Access via:



**VRE** Virtual Research Environment  
vre.charite.de



<https://marketplace.eosc-portal.eu/services/secure-virtual-research-environment-vre-for-sensitive-data>

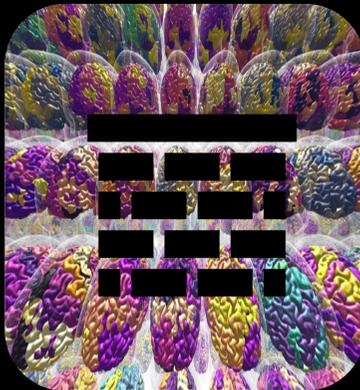
# Technical and Organizational Measures

## Critical infrastructure certification



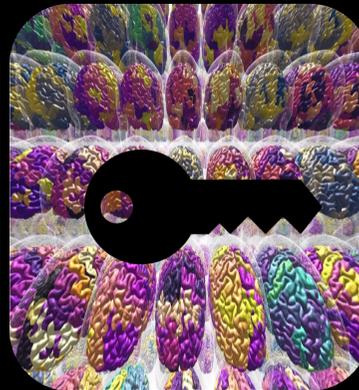
- ✓ IT Infrastructure with state of the art security measures and industry best practice

## Isolation of data and resources



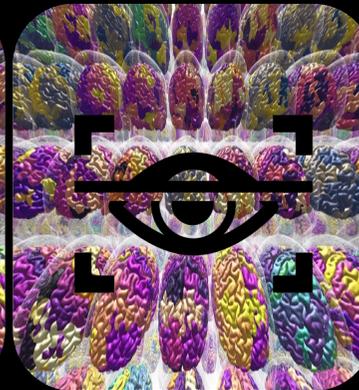
- ✓ Namespaces
- ✓ Filter
- ✓ Firewalls
- ✓ proxy nodes

## Encryption



- ✓ Sensitive data is always encrypted by default and only decrypted during the actual processing
- ✓ Unencrypted data is sandboxed during processing

## Authentication & authorization



- ✓ Keycloak/OpenID Connect for single sign-on and to authenticate communications between the frontend, API Gateway (which connects all back-end services)
- ✓ Identity of users federated between nodes
- ✓ Registration with form of personal identification
- ✓ Password complexity and session inactivity timeouts

## Access control



- ✓ Fine-grained role-based and project-based access control
- ✓ A user may be a member of multiple projects and may have different roles in each project
- ✓ Roles mapped to roles concept of GDPR

## Supervisory Authorities

EU, Federal, State



### Processor

Maintains the Data Platform.

Implements Technical and Organizational Measures

Processes data on behalf of the controller.



### Data Platform

A secure data processing environment



### Data Protection Officer

Designated by the controller and processor

Involved in issues relating to protection of personal data.



### Controller

Determines the purpose and means of processing

Prepares a data protection impact assessment for the research study



### Research Ethics Board

Ethical evaluation of the research project



### Derivative Datasets

Dataset use terms

Data Processing Agreement with receiving data controller



### Data Subject

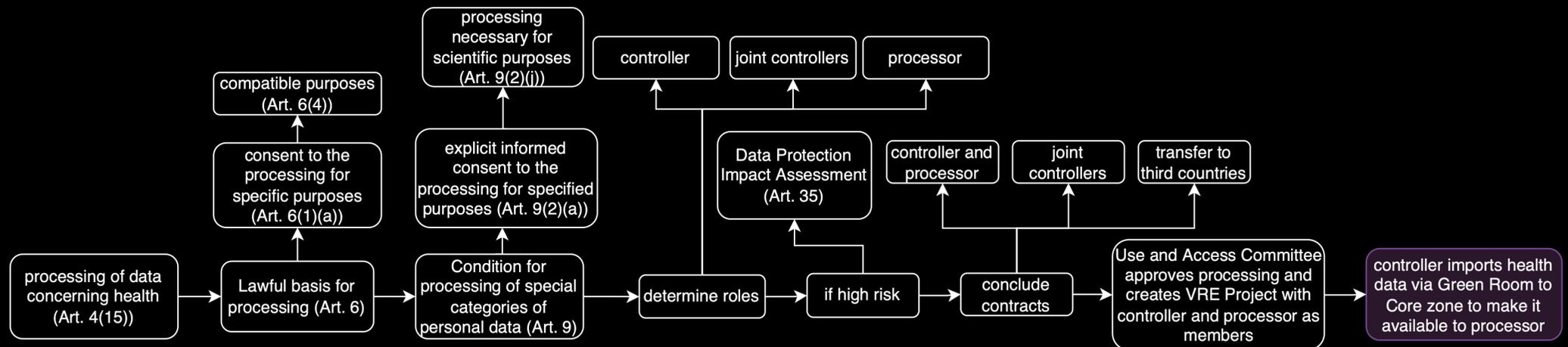
An identified or identifiable natural person whose personal data is the subject of processing.

Consents to their data being used and shared for research



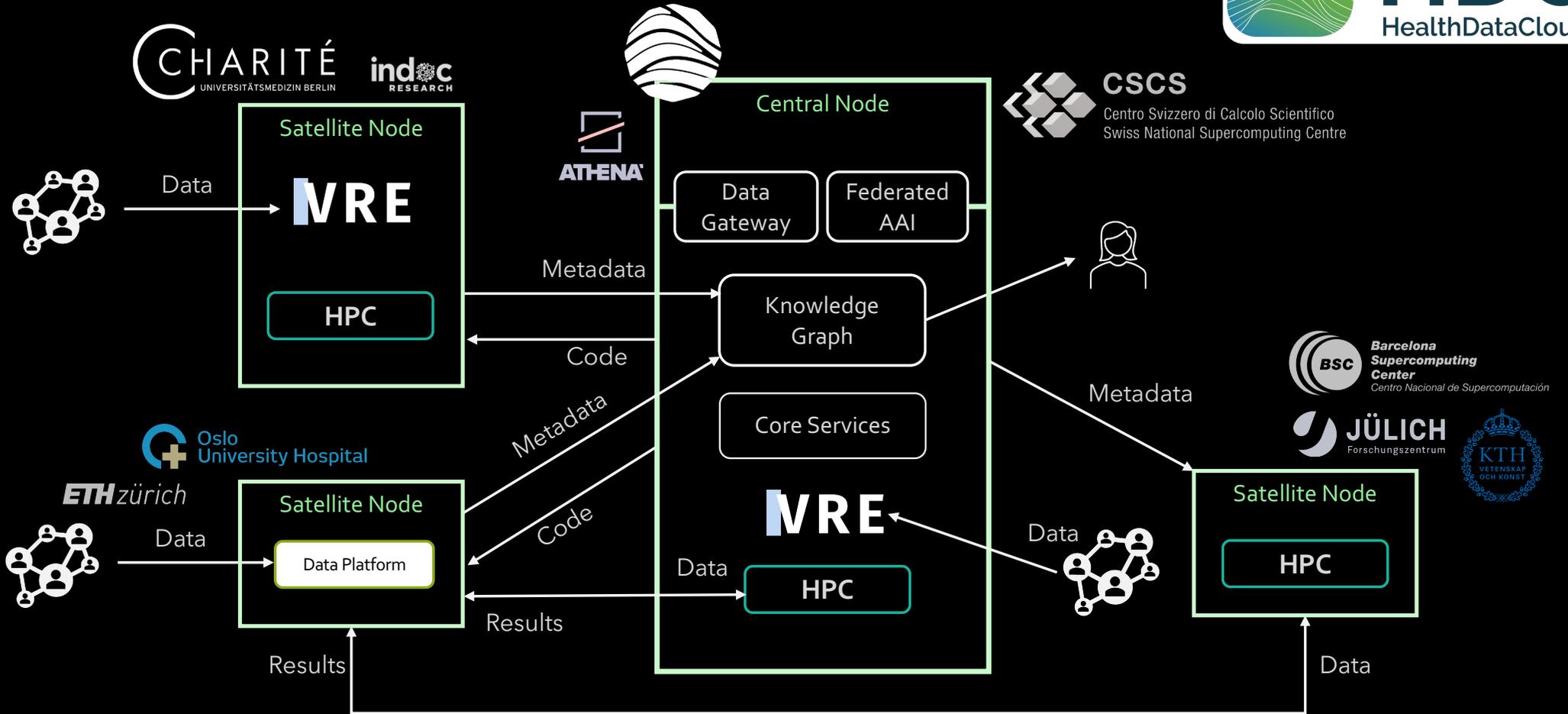
# Technical and Organizational Measures

Roles of actors map to legal framework & governance model



- Only after the **Legal Controller** approved all necessary contracts a dedicated VRE Project is created by a **Platform Administrator** and adds the specified controller and processor as team members
- Controller can make it available to processors for performing the processing operation

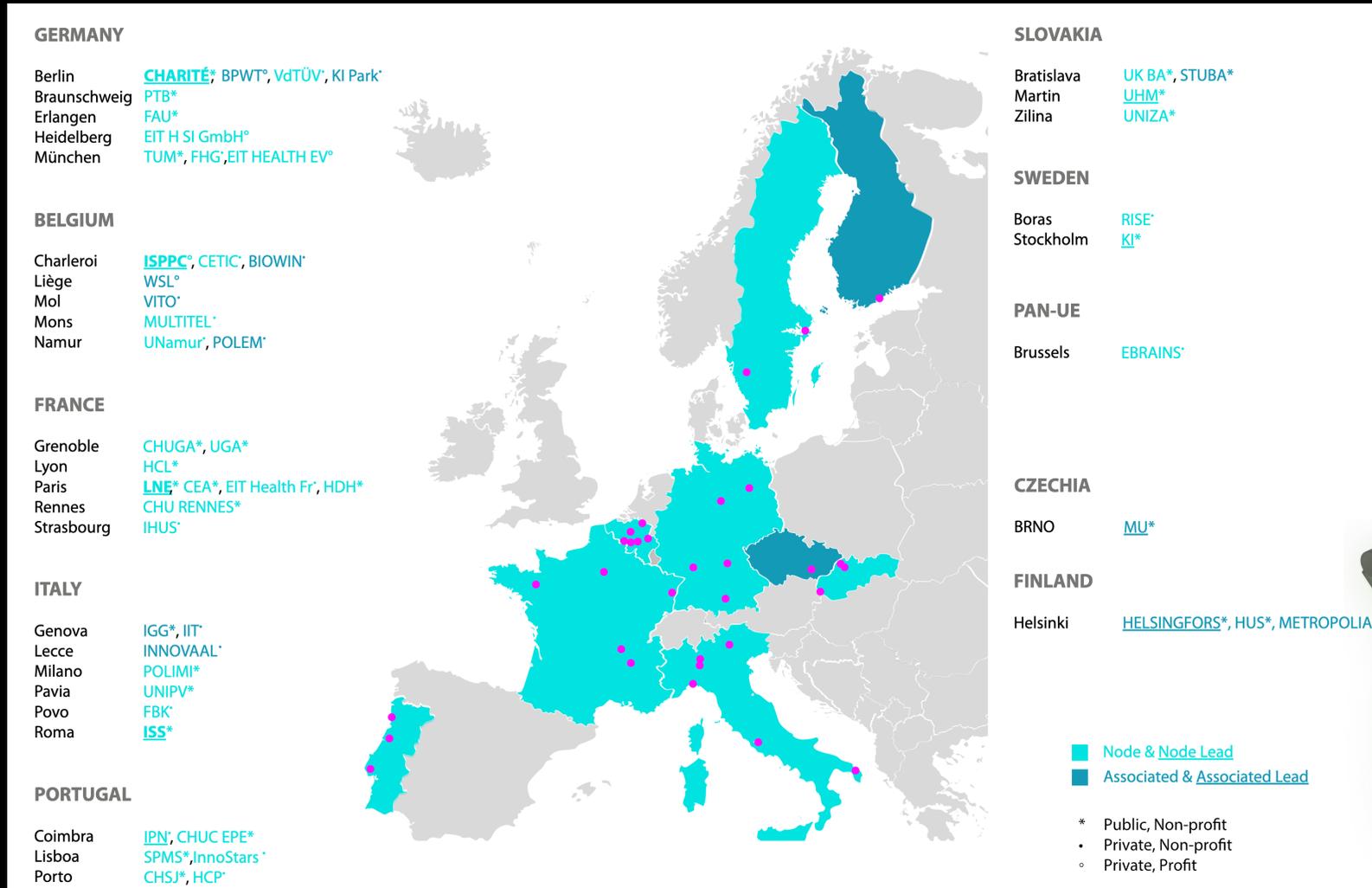
# EBRAINS Health Data Cloud



[www.healthdatacloud.eu](http://www.healthdatacloud.eu)



# Testing and Experimentation Facility for Health AI and Robotics (TEF-Health)

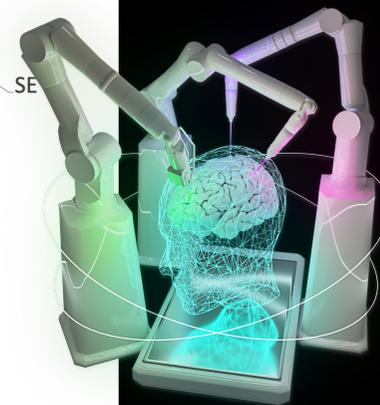
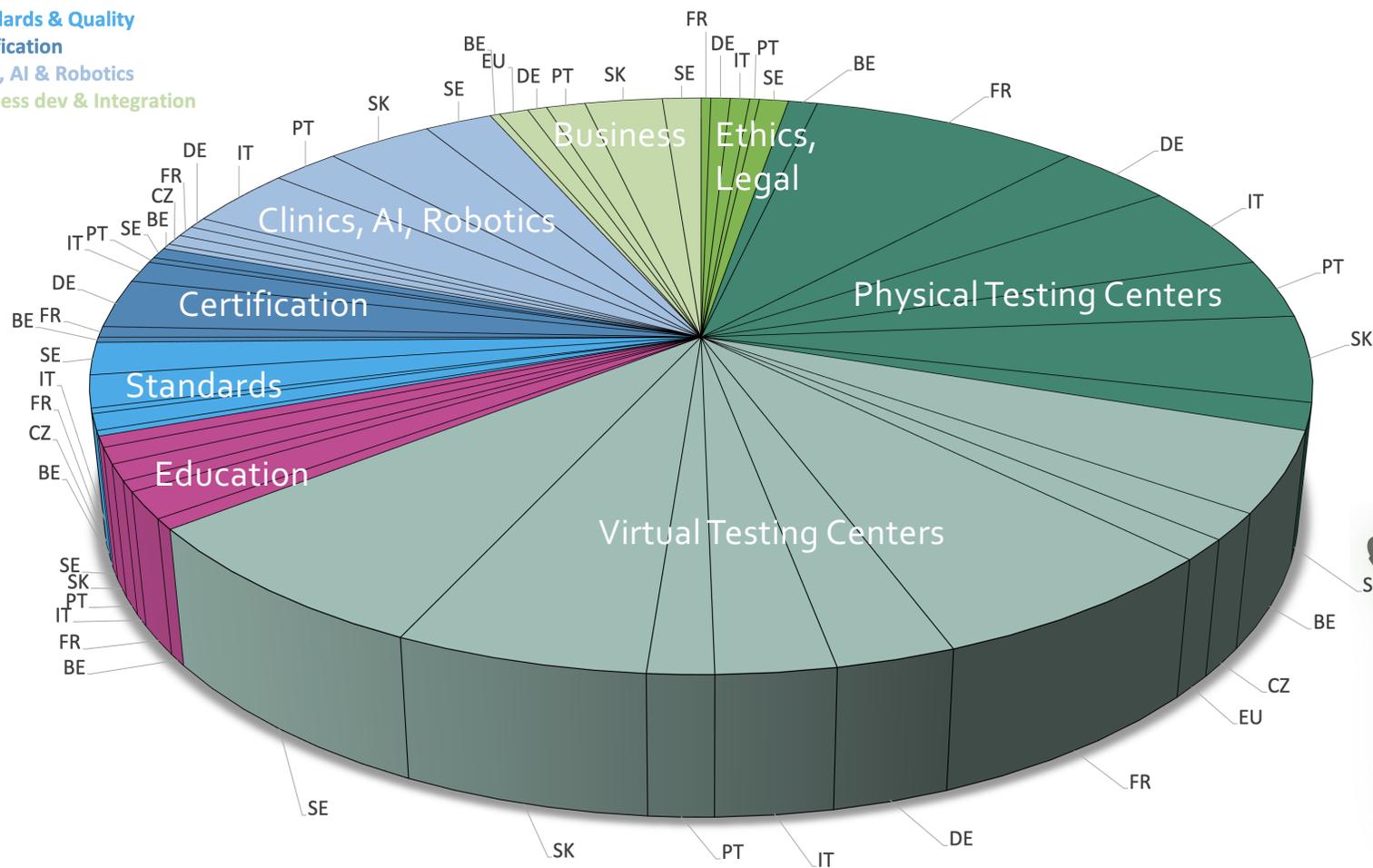




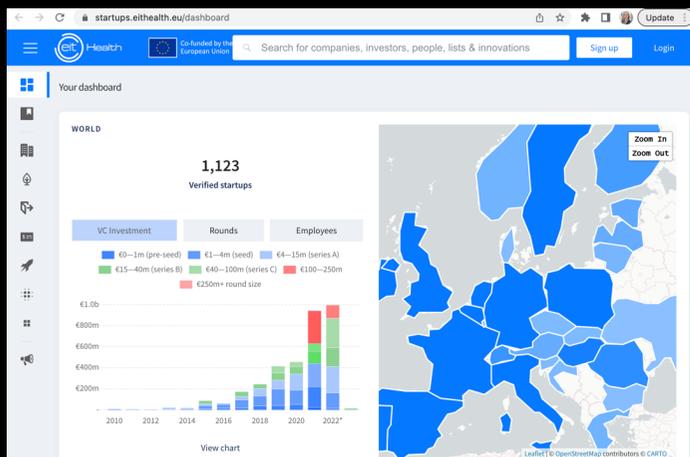
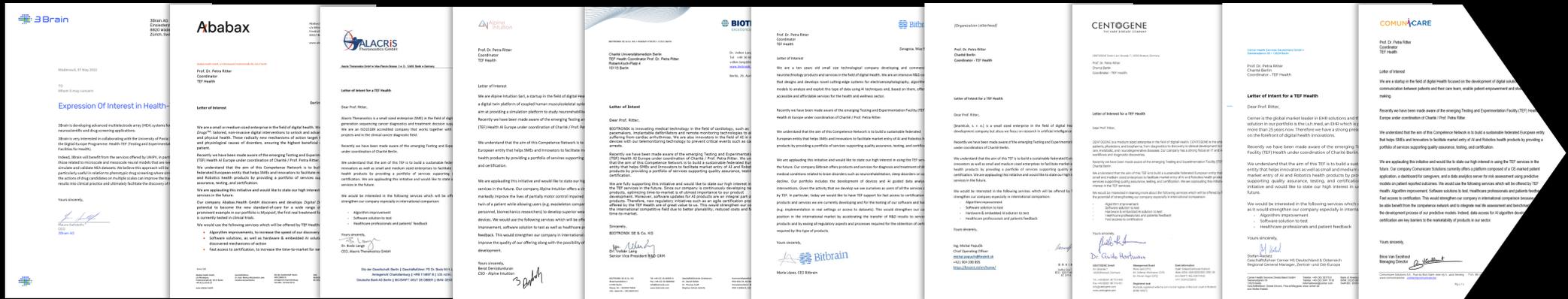
# TEF-Health Services

- Ethics, Legal & Society
- Physical Testing Centers
- Virtual Testing Centers
- Education & Dissimination
- Standards & Quality
- Certification
- Clinic, AI & Robotics
- Business dev & Integration

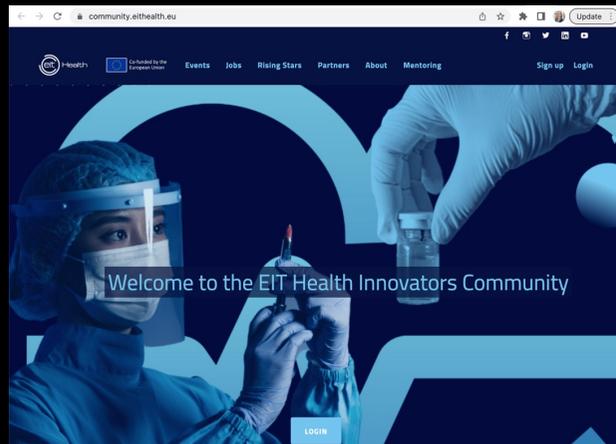
## SERVICES ACROSS ALL TEF-HEALTH NODES



# Services for Startups and SMEs



<https://startups.eithealth.eu>



<https://community.eithealth.eu/>



# Partnering with European Digital Innovation Hubs (EDIH)

## Digital Innovation Hubs

DIHs **European DIHs**

**Search**

**Countries**  
Select an item

**Technologies**  
Select an item

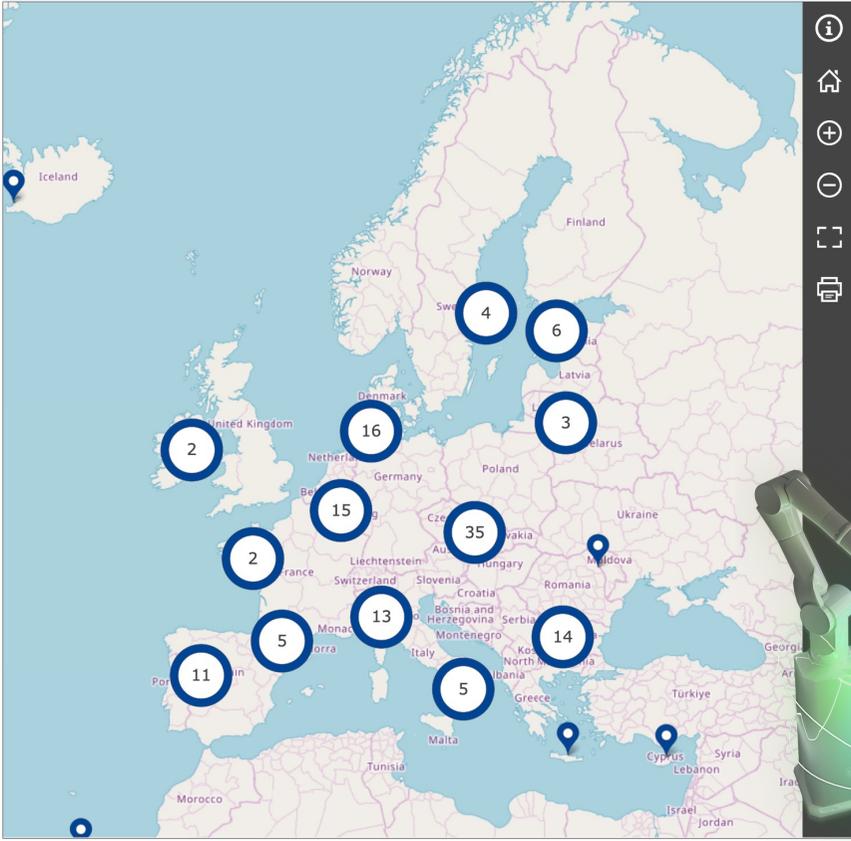
**Services Provided**  
Select an item

**Sectors**  
Select an item

**Type**  
European DIH

**Internal Hub Id**

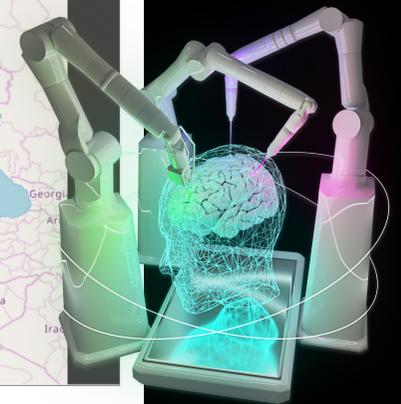
Contact us in the following email: [JRC-DIH@ec.europa.eu](mailto:JRC-DIH@ec.europa.eu)



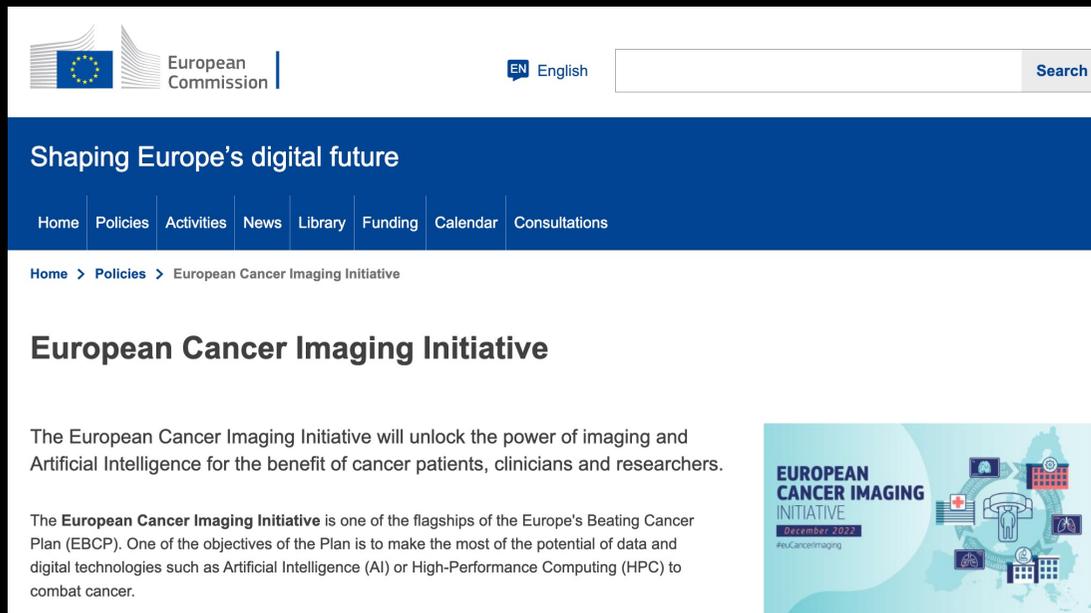
The map shows 16 numbered blue circles representing Digital Innovation Hubs across Europe. The numbers are: 2 (UK), 2 (France), 5 (Spain), 11 (Spain), 5 (Italy), 13 (Italy), 15 (Germany), 16 (Germany), 4 (Sweden), 6 (Finland), 3 (Poland), 35 (Czechia), 14 (Romania), and 5 (Greece). There are also location pins for Iceland, Malta, Cyprus, and Lebanon.

Webtools: © EC GISCO + Leaflet | © OpenStreetMap | Disclaimer

<https://s3platform.jrc.ec.europa.eu/>



# Partnering with #euCancerImaging



The screenshot shows the top navigation bar of the European Commission website. It includes the European Commission logo, a language selector set to 'English', and a search bar. Below the navigation bar is a blue header with the text 'Shaping Europe's digital future' and a menu of links: Home, Policies, Activities, News, Library, Funding, Calendar, and Consultations. The main content area has a breadcrumb trail: Home > Policies > European Cancer Imaging Initiative. The title 'European Cancer Imaging Initiative' is prominently displayed. Below the title, there are two paragraphs of text. The first paragraph states: 'The European Cancer Imaging Initiative will unlock the power of imaging and Artificial Intelligence for the benefit of cancer patients, clinicians and researchers.' The second paragraph states: 'The **European Cancer Imaging Initiative** is one of the flagships of the Europe's Beating Cancer Plan (EBCP). One of the objectives of the Plan is to make the most of the potential of data and digital technologies such as Artificial Intelligence (AI) or High-Performance Computing (HPC) to combat cancer.' To the right of the text is a small version of the initiative's logo, which features a map of Europe with various icons representing medical and technological aspects.

European Commission

English

Search

Shaping Europe's digital future

Home Policies Activities News Library Funding Calendar Consultations

Home > Policies > European Cancer Imaging Initiative

## European Cancer Imaging Initiative

The European Cancer Imaging Initiative will unlock the power of imaging and Artificial Intelligence for the benefit of cancer patients, clinicians and researchers.

The **European Cancer Imaging Initiative** is one of the flagships of the Europe's Beating Cancer Plan (EBCP). One of the objectives of the Plan is to make the most of the potential of data and digital technologies such as Artificial Intelligence (AI) or High-Performance Computing (HPC) to combat cancer.



<https://digital-strategy.ec.europa.eu/en/policies/cancer-imaging>

# AI Regulatory Sandboxes

*‘AI regulatory sandboxes established by one or more Member States competent authorities or the European Data Protection Supervisor shall provide a controlled environment that facilitates the development, testing and validation of innovative AI systems for a limited time before their placement on the market or putting into service pursuant to a specific plan [...] under the direct supervision and guidance by the competent authorities with a view to ensuring compliance with [...]this Regulation and, where relevant, other [...] legislation supervised within the sandbox.’*

Art. 53(1) AI Act (Commission proposal)

## Promote trust & excellence in AI

- Art. 53 AIA – Framework and legal basis for AI regulatory sandboxes
- Art. 53(6) AIA – Implementing acts on the modalities for operation
- Art. 54 AIA – Legal basis for further processing of personal data



Users with Accounts:

**6000**

**EBRAINS is powering a new era  
in Brain Research**



### Data and Knowledge

- Online solutions to facilitate sharing of and access to research data, computational models and software



### Atlases

- Navigate, characterise and analyse information on the basis of anatomical location



### Simulation

- Solutions for brain researchers to conduct sustainable simulation studies and share their results



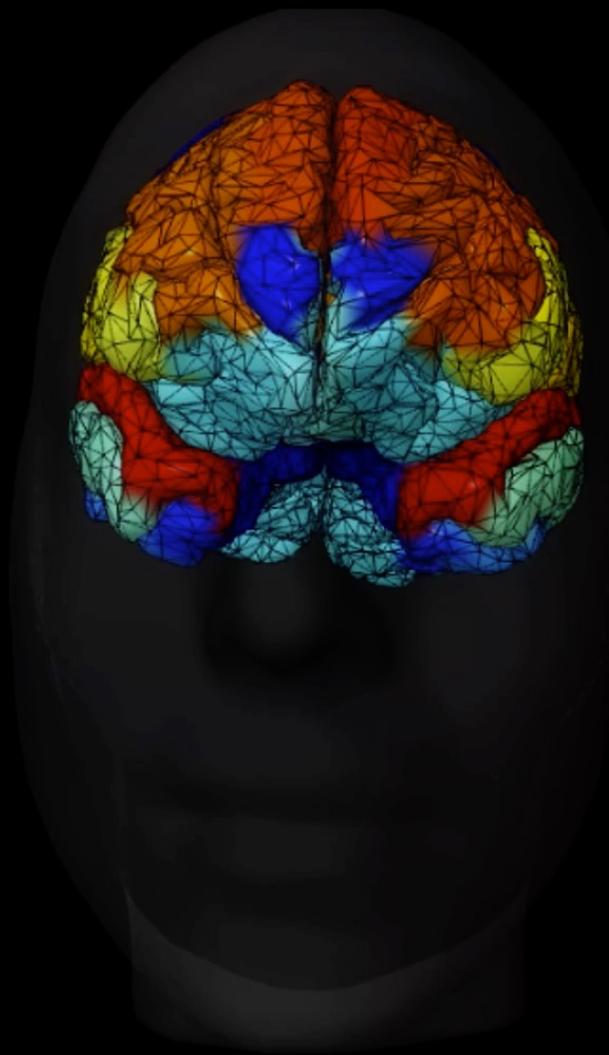
### Brain-Inspired Technologies

- Understand and leverage the computational capabilities of spiking neural networks



### Medical Data Analytics

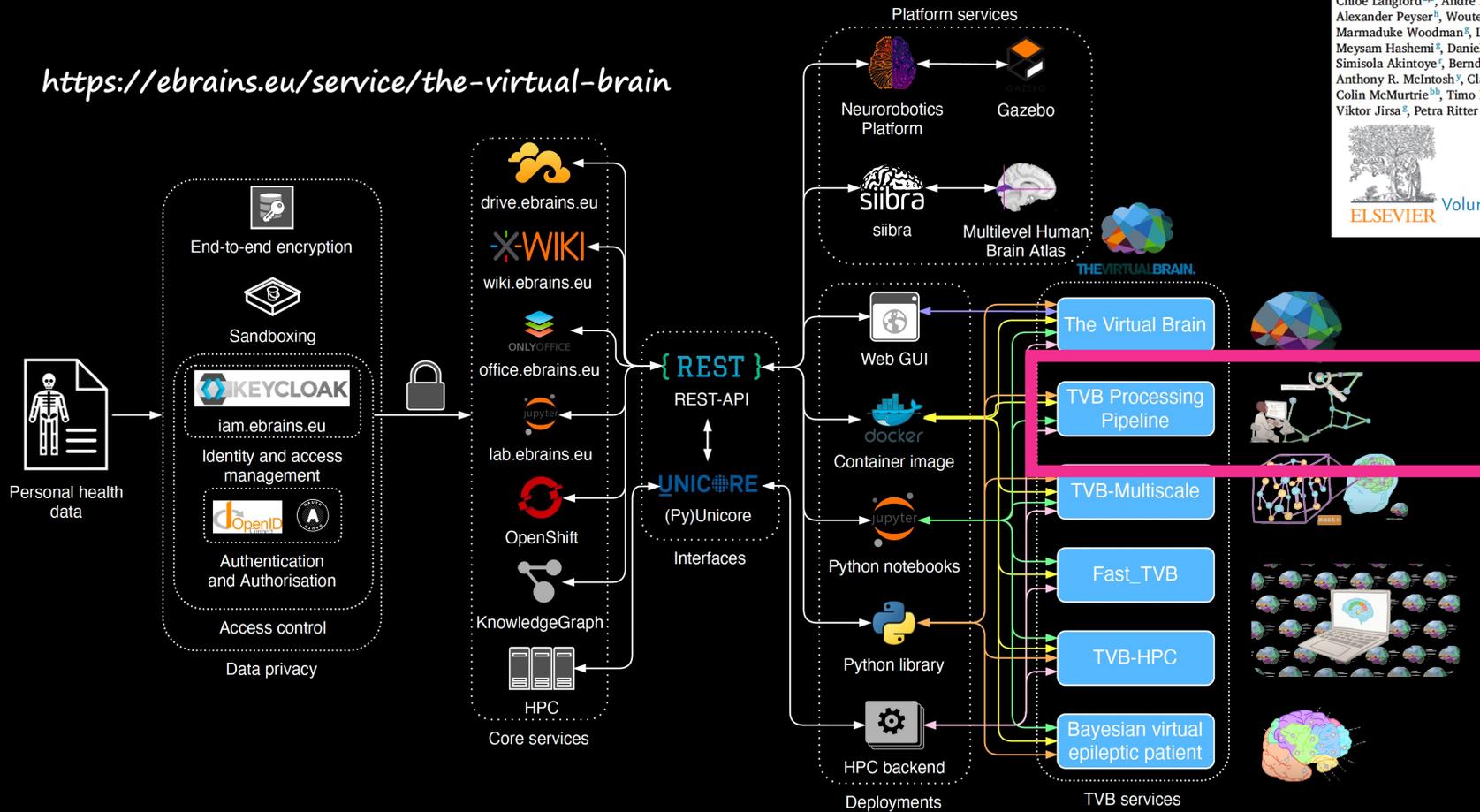
- The Medical Data Analytics service provides two unique EBRAINS platforms, covering key areas in clinical neuroscience research



Ritter, P., M. Schirner, A. R. McIntosh and V. K. Jirsa (2013). "The virtual brain integrates computational modeling and multimodal neuroimaging." *Brain Connect* 3(2): 121-145.

# EBRAINS ESFRI Research Infrastructure

<https://ebrains.eu/service/the-virtual-brain>



Brain simulation as a cloud service: The Virtual Brain on EBRAINS

Michael Schirner<sup>a,b,c,d,e,f,g</sup>, Lia Domide<sup>f</sup>, Dionysios Perdakis<sup>a,b</sup>, Paul Triebkorn<sup>a,b,h</sup>, Leon Stefanovski<sup>a,b</sup>, Roopa Pai<sup>a,b</sup>, Paula Prodan<sup>i</sup>, Bogdan Valean<sup>i</sup>, Jessica Palmer<sup>a,b</sup>, Chloé Langford<sup>a,b</sup>, André Blickensdörfer<sup>a,b</sup>, Michiel van der Vlag<sup>h</sup>, Sandra Diaz-Pier<sup>h</sup>, Alexander Peyser<sup>h</sup>, Wouter Klijn<sup>h</sup>, Dirk Pleiter<sup>h</sup>, Anne Nahm<sup>i</sup>, Oliver Schmid<sup>k</sup>, Marmaduke Woodman<sup>g</sup>, Lyuba Zehl<sup>l</sup>, Jan Fousek<sup>g</sup>, Spase Petkoski<sup>g</sup>, Lionel Kusch<sup>g</sup>, Meysam Hashemi<sup>g</sup>, Daniele Marinazzo<sup>m,n</sup>, Jean-François Mangin<sup>o</sup>, Agnes Flöel<sup>p,q</sup>, Simisola Akintoye<sup>r</sup>, Bernd Carsten Stahl<sup>h</sup>, Michael Cepic<sup>i</sup>, Emily Johnson<sup>i</sup>, Gustavo Deco<sup>h,v,w,x</sup>, Anthony R. McIntosh<sup>y</sup>, Claus C. Hilgetag<sup>z,aa</sup>, Marc Morgan<sup>k</sup>, Bernd Schuller<sup>l</sup>, Alex Upton<sup>bb</sup>, Colin McMurtrie<sup>bb</sup>, Timo Dickscheid<sup>i</sup>, Jan G. Bjaalle<sup>cc</sup>, Katrin Amunts<sup>l,dd</sup>, Jochen Mersmann<sup>ee</sup>, Viktor Jirsa<sup>g</sup>, Petra Ritter<sup>h,b,c,d,e,f,g</sup>

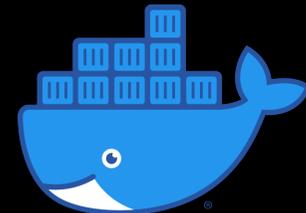
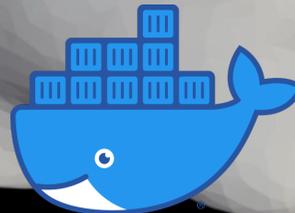
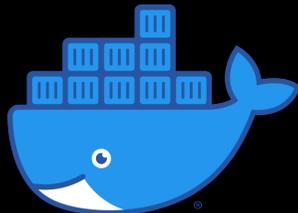


NeuroImage

Volume 251, 1 May 2022, 118973

Access control, encryption and sandboxing

# Container workflows for building digital twins



NeuroImage 117 (2015) 343-357

Contents lists available at ScienceDirect

**NeuroImage**

journal homepage: [www.elsevier.com/locate/ynimg](http://www.elsevier.com/locate/ynimg)

**ELSEVIER**

**CrashMark**

An automated pipeline for constructing personalized virtual brains from multimodal neuroimaging data

Michael Schirner<sup>a,b,1</sup>, Simon Rothmeier<sup>a,b,1</sup>, Viktor K. Jirsa<sup>c</sup>, Anthony Randal McIntosh<sup>d</sup>, Petra Ritter<sup>a,b,e,f,\*</sup>

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NeuroImage 251 (2022) 118973

Contents lists available at ScienceDirect

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**ELSEVIER**

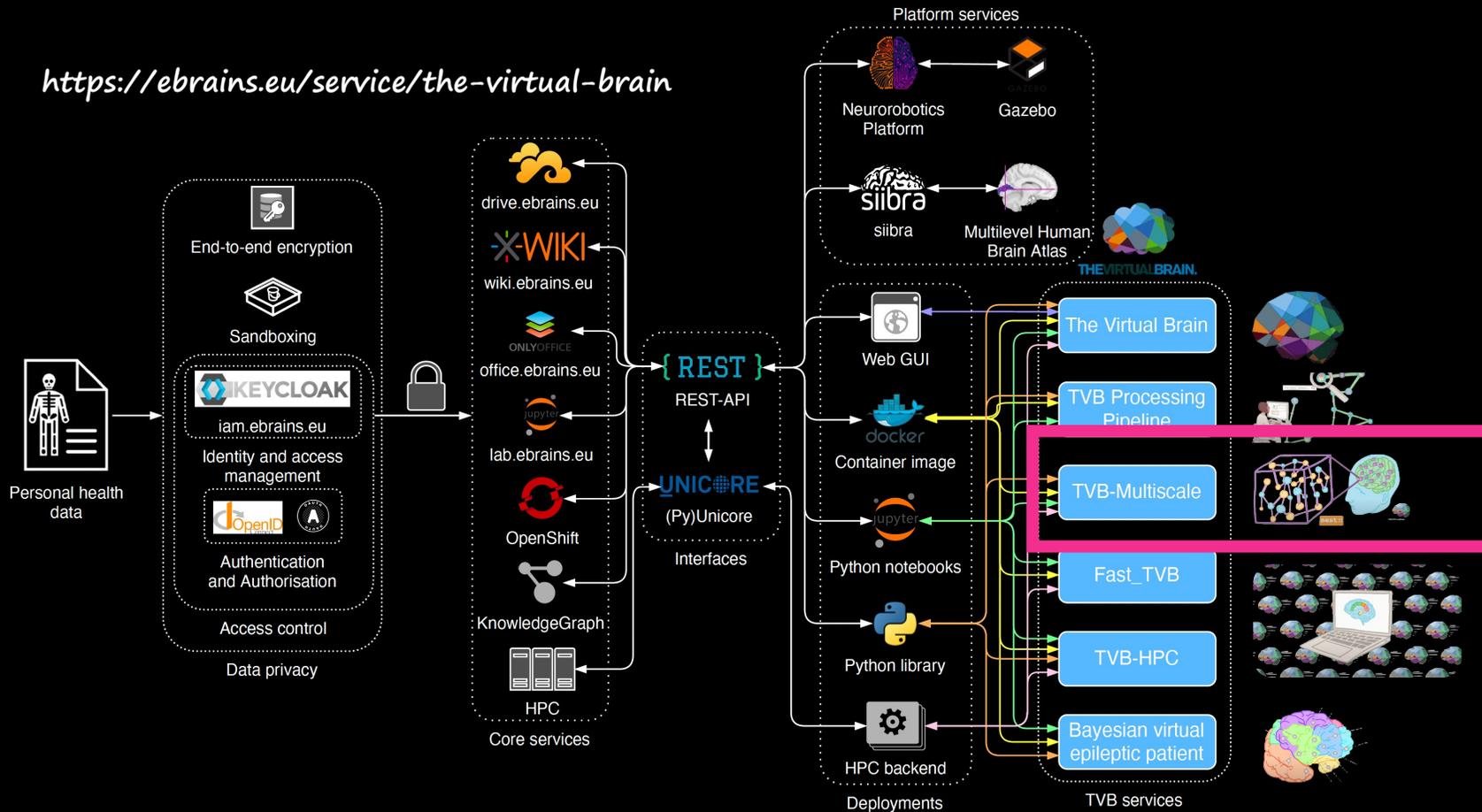
**Check for updates**

**Brain simulation as a cloud service: The Virtual Brain on EBRAINS**

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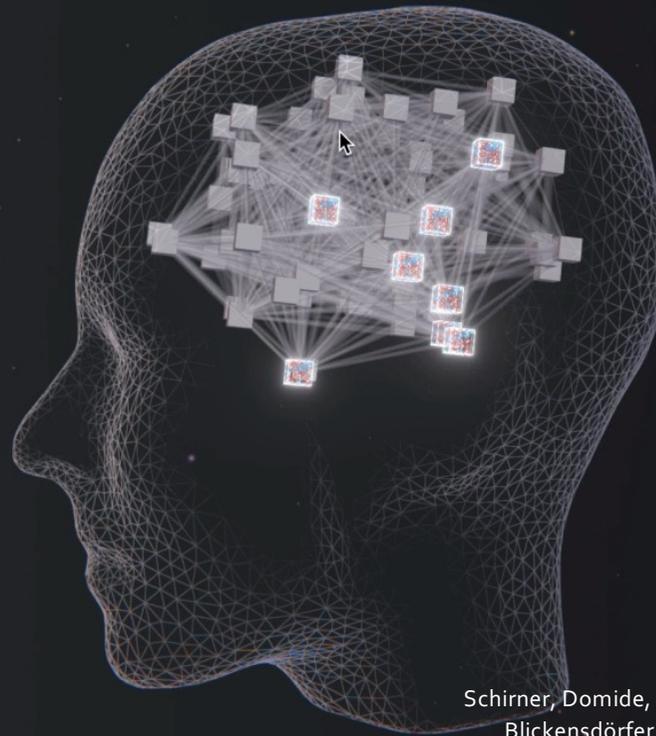
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<https://ebrains.eu/service/the-virtual-brain>



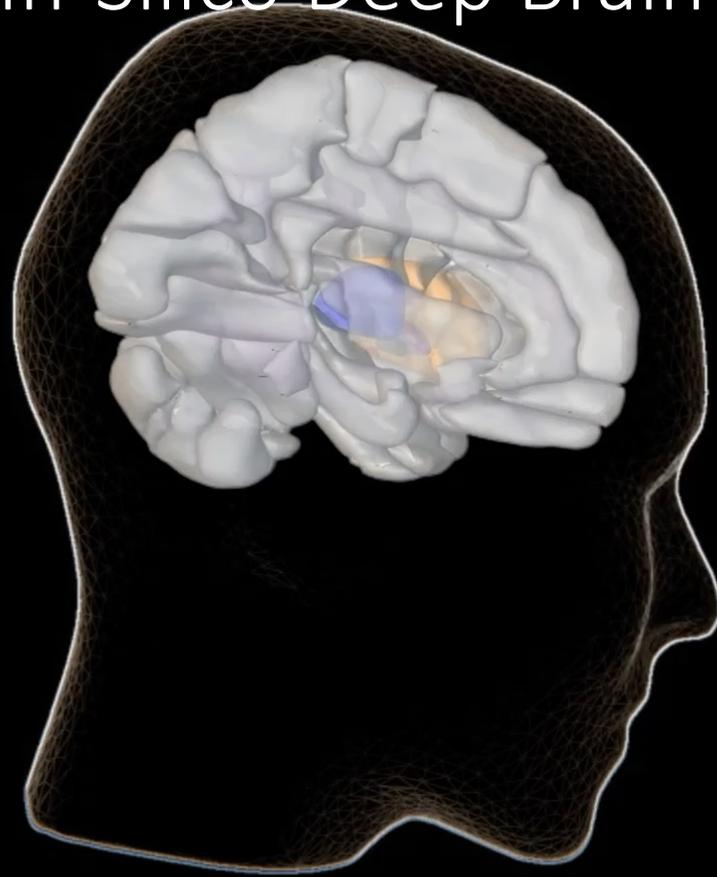
*Access control, encryption and sandboxing*

# Multiscale Co-Simulation



Schirner, Domide, Perdakis, Triebkorn, Stefanovski, Pai, Popa, Valean, Palmer, Langford, Blickensdörfer, van der Vlag, Diaz-Pier, Peyser, Woodman, Zehl, Fousek, Petkoski, Kusch, Hashemi, Marinazzo, Mangin, Flöel, Akintoye, Stahl, Deco, McIntosh, Hilgetag, Morgan, Schuller, Upton, McMurtrie, Dickscheid, Bjaalie, Amunts, Mersmann, Jirsa, Ritter **Brain Simulation as a Service: The Virtual Brain on EBRAINS**. (2022) Neuroimage

# In-Silico Deep Brain Stimulation

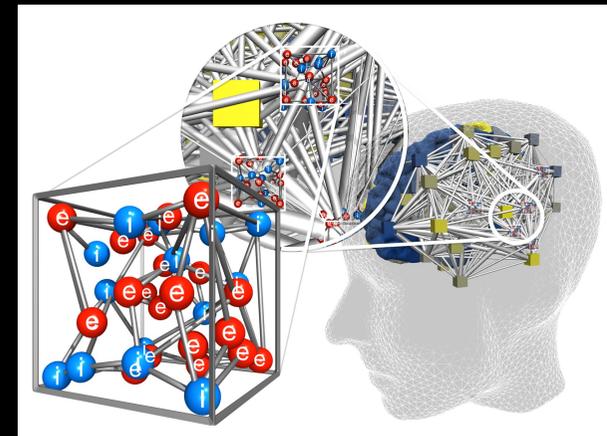


**EJN**

European Journal  
of Neuroscience

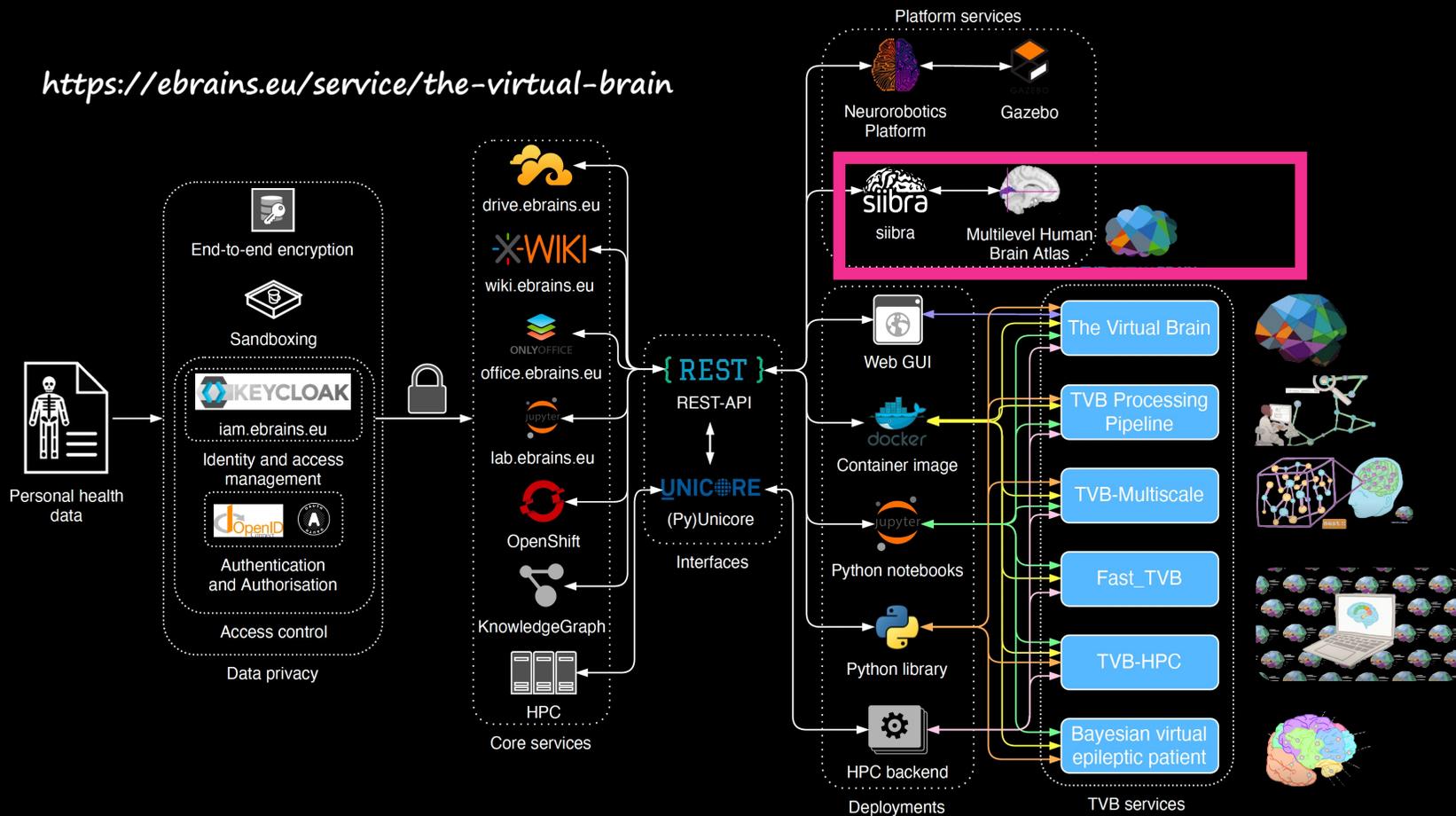
**Virtual deep brain stimulation: Multiscale co-simulation of a spiking basal ganglia model and a whole-brain mean-field model with The Virtual Brain**

 Jil M. Meier, Dionysios Perdikis, André Blickensdörfer, Leon Stefanovski, Qin Liu, Oliver Maith, Helge Ü. Dinkelbach, Javier Baladron, Fred H. Hamker, Petra Ritter



# Linking TVB and Digital Atlases

<https://ebrains.eu/service/the-virtual-brain>



*Access control, encryption and sandboxing*

# Integrating data from digital atlases into brain models – using standardized spatial reference spaces



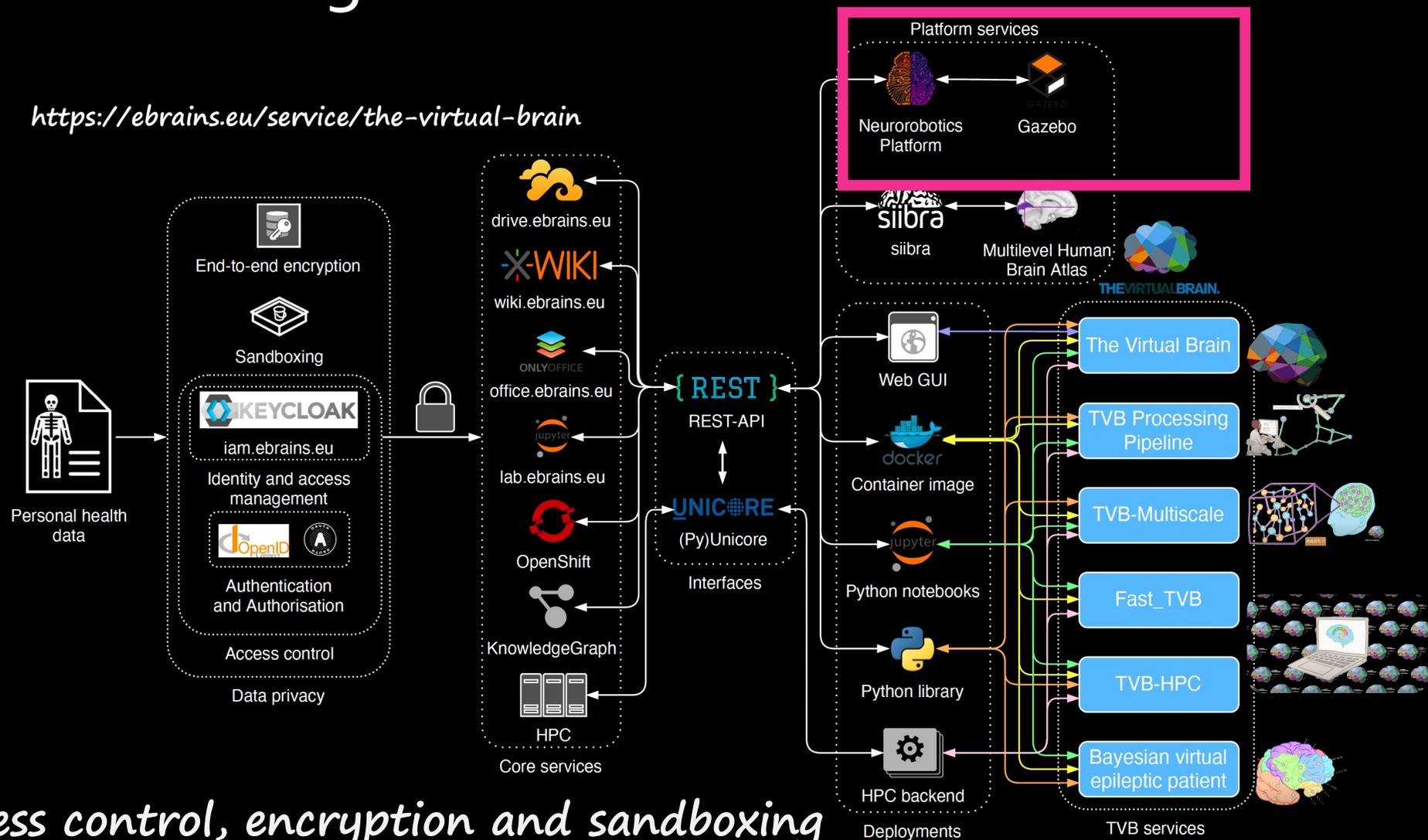
# Integrating data from knowledge graphs into brain models – using standardized spatial reference spaces



Stefanovski, Triebkorn, Spiegler, Diaz-Cortes, Solodkin, Jirsa, Randal McIntosh, Ritter; for the Alzheimer's Disease Neuroimaging Initiative (2019). Linking molecular pathways and large-scale computational modeling to assess candidate disease mechanisms and pharmacodynamics in Alzheimer's disease. *Frontiers Computational Neuroscience*

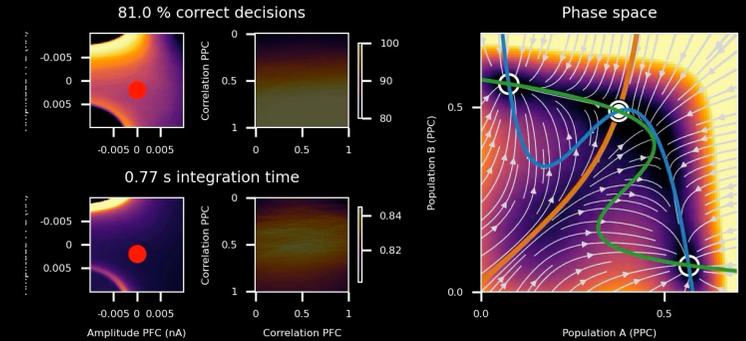
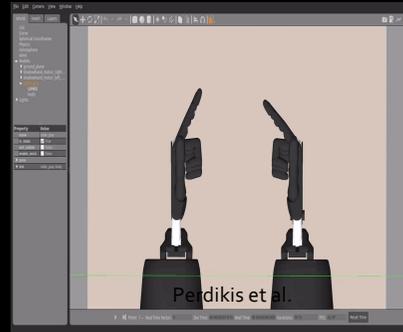
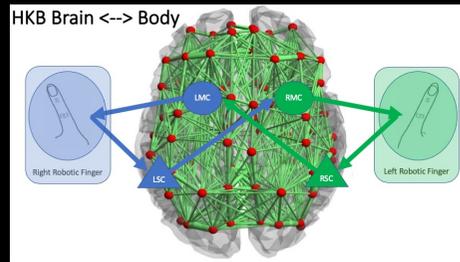
# Connecting The Virtual Brain to a Virtual Robot

<https://ebrains.eu/service/the-virtual-brain>



*Access control, encryption and sandboxing*

# Robotics & Behavior



Schirner, Deco & Ritter (2023) Learning how network structure shapes decision-making for bio-inspired computing. **Nature Communications** (in press)

Bitbrain

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Advanced neurotechnology

Bitbrain® is a neurotechnology company that combines neuroscience, artificial intelligence, and hardware to develop innovative products.

High-tech EEG brain sensing devices and software solutions for real-world human behaviour research, health and neurotechnology development.

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Technology for Neurorehabilitation

# Ethics and Outreach



WORLD HEALTH SUMMIT 2022

OCTOBER 16-18 BERLIN, GERMANY & DIGITAL




## EU Parliament Lunch Debates

2021



### Digital Data for Dementia Research and Innovation



“World-wide exchange of data is crucial. Data privacy is also crucial. There is no simple solution to simultaneously and efficiently meet both these needs. The solution proposed by Virtual Brain Cloud is to use encryption, sandboxing and access control as technical means to protect personal data.”

**Professor Petra Ritter**  
Berlin Institute of Health  
Charité – Universitätsmedizin Berlin

 #AEParlamentWorkshop

2022



### European Parliament Lunch Debate

The role of artificial intelligence and big data in dementia research



“Trustable digital twin technologies and AI applications in health rely on the large-scale availability of interoperable health data, and data infrastructures that meet GDPR requirements for patient privacy. In Virtual Brain Cloud and EBRAIN-Health, we are developing solutions to meet these needs.”

**Petra Ritter**  
Project Coordinator, VirtualBrain-Cloud; Berlin Institute of Health at Charité University Hospital

 #AELunchDebate

Thank you!

