



Human Brain Project



EBRAINS

EBRAINS and the Virtual Brain Twin

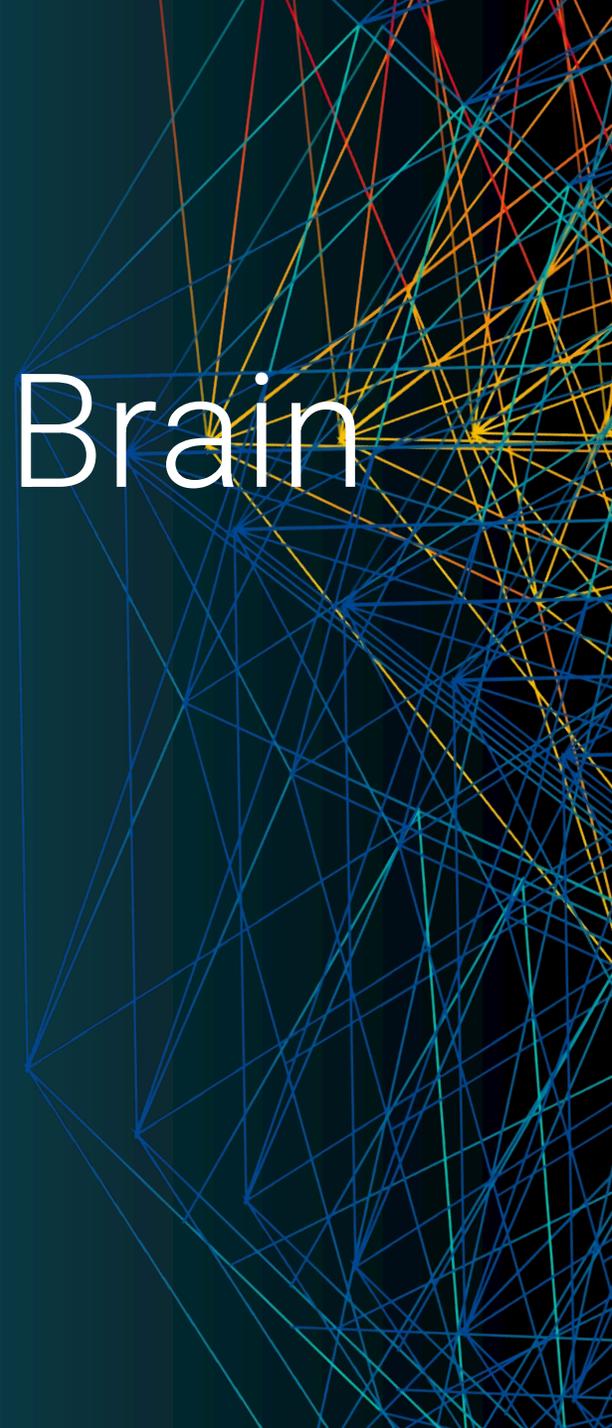
Viktor Jirsa



Institut de
Neurosciences
des Systèmes

Aix-Marseille
université

Inserm

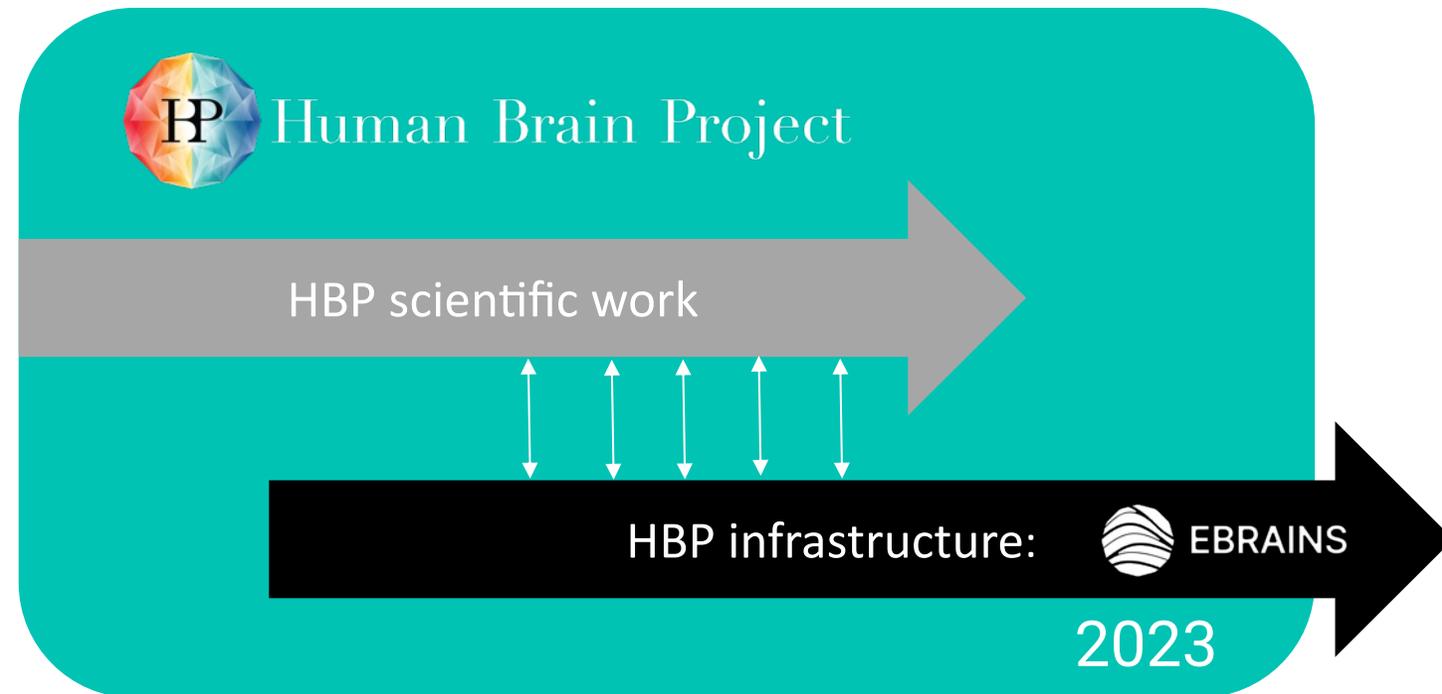


EBRAINS enables brain research advances and innovation

EBRAINS has been built by the **Human Brain Project** and will continue beyond **2023** as its legacy

HBP objectives

- Build better understanding of Brain Function
- Translate understanding into Brain Medicine
- Develop applications in Brain-derived technology

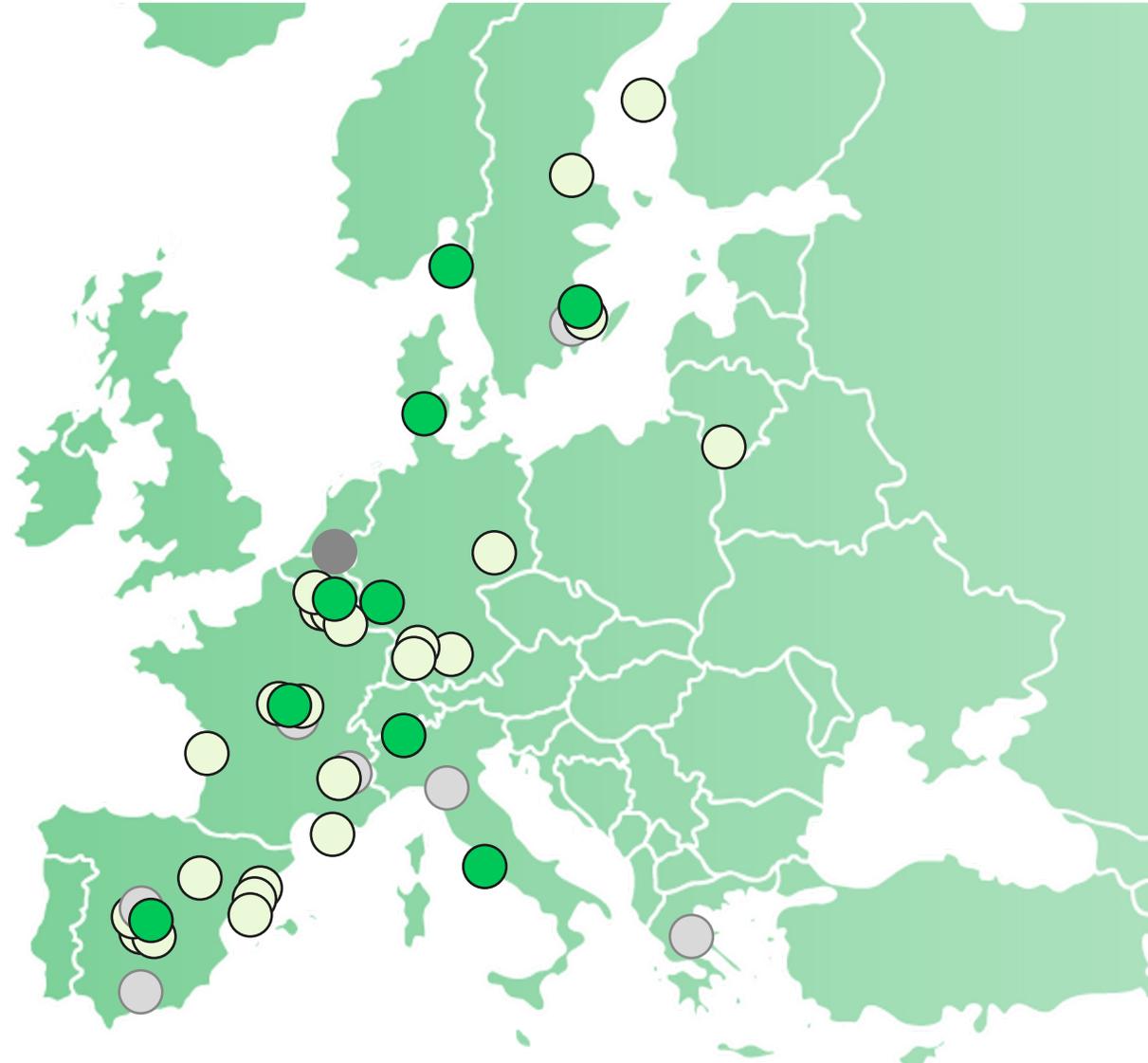


EBRAINS AISBL Members

	Members		Application Full Member
	Associate Members		Application Associate Member

- 1 - Full - France - Commissariat à l'énergie atomique
- 2 - Full - Germany - Forschungszentrum Jülich
- 3 - Full - Norway - University of Oslo
- 4 - Full - Spain - Universidad Politécnica de Madrid
- 5 - Full - Sweden - Royal Institute of Technology
- 6 - Full - Switzerland - École Polytechnique Fédérale de Lausanne
- 7 - Full - Italy - Consiglio Nazionale delle Ricerche
- 8 - Associate - Germany - Charité – Universitätsmedizin Berlin
- 9 - Associate - France - Aix-Marseille Université
- 10 - Associate - Spain - Bit&Brain Technologies, S.L.
- 11 - Associate - Spain - Institut D'Investigacions Biomèdiques August Pi i Sunyer
- 12 - Associate - Spain - Fundación Sant Joan de Déu
- 13 - Associate - Spain - Quirónsalud
- 14 - Associate - Spain - Universidad Rey Juan Carlos
- 15 - Associate - Spain - Fundació Institut de Bioenginyeria de Catalunya
- 16 - Associate - Germany - Central Institute of Mental Health
- 17 - Associate - France - Université Grenoble Alpes
- 18 - Associate - Sweden - Karolinska Institutet
- 19 - Associate - Belgium - Vrije Universiteit Brussel

- 20 - Associate - Sweden - Umeå University
- 21 - Full - Belgium - Universiteit Hasselt
- 22 - Associate - Spain - Fundación de Investigación HM Hospitales
- 23 - Associate - Germany - Universität Heidelberg
- 24 - Associate - Germany - Heidelberger Institut für Theoretische Studien gGmbH
- 25 - Associate - Belgium - Universiteit Antwerpen
- 26 - Associate - Belgium - Katholieke Universiteit Leuven
- 27 - Associate - France - Institut du Cerveau et de la Moelle épinière
- 28 - Associate - France - Institut national de la santé et de la recherche médicale
- 29 - Associate - Sweden - Mittuniversitetet
- 30 - Associate - Lithuania - Lietuvos sveikatos mokslų universitetas
- 31 - Associate - Belgium - Universiteit Gent
- 32 - Full - Denmark - Fonden Teknologirådet
- 33 - Associate - France - Université de Bordeaux



On-going applications (waiting for Accession Agreement or BoD Decision)

- 1 - Associate - Sweden - Stockholm University
- 2 - Full - The Netherlands - Stichting Radboud Universiteit
- 3 - Associate - Italy - Università degli studi di Modena e Reggio
- 4 - Associate - Greece - Athena Research & Innovation Center
- 5 - Associate - France - Fonds de Dotation Clnatec
- 6 - Associate - Spain - Agencia Estatal Consejo Superior de Investigaciones Científicas
- 7 - Associate - France - Centre national de la recherche scientifique
- 8 - Associate - Spain - Universidad de Granada



Interoperability at the core

EBRAINS Research Infrastructure's uniqueness resides in our ambition to make extensive brain data, tools, and models interoperable. This enables researchers to bridge data scales and draw on work from across disciplines to address questions in neuroscience that have been roadblocks for progress.

[Read the EBRAINS Science Vision](#) 

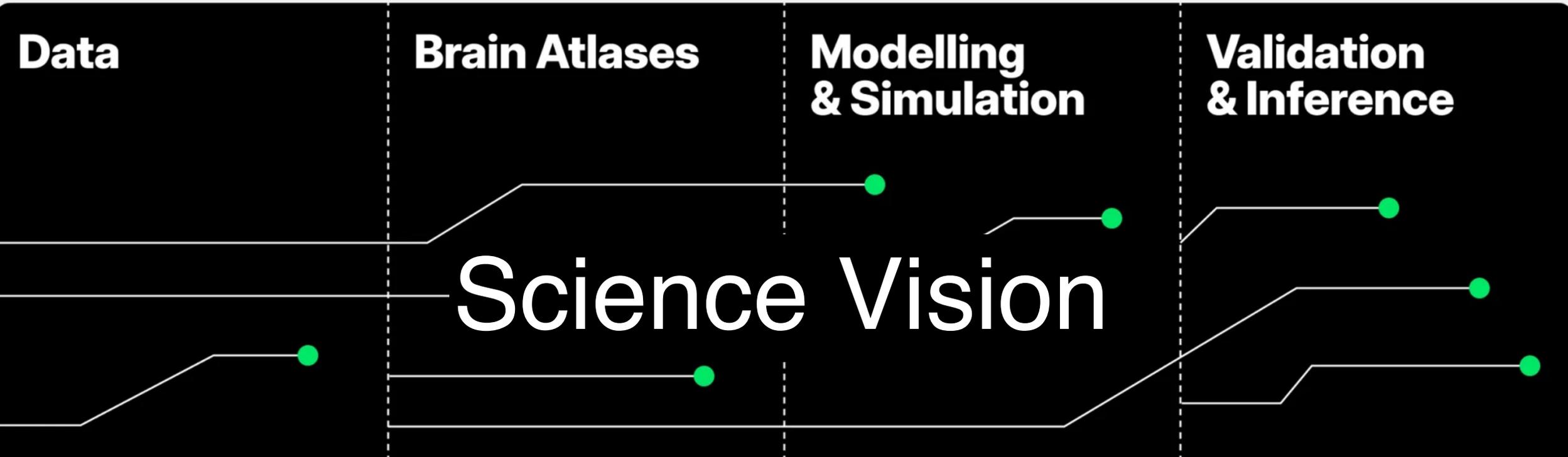
Data

Brain Atlases

**Modelling
& Simulation**

**Validation
& Inference**

Science Vision



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Human Brain Project



EBRAINS



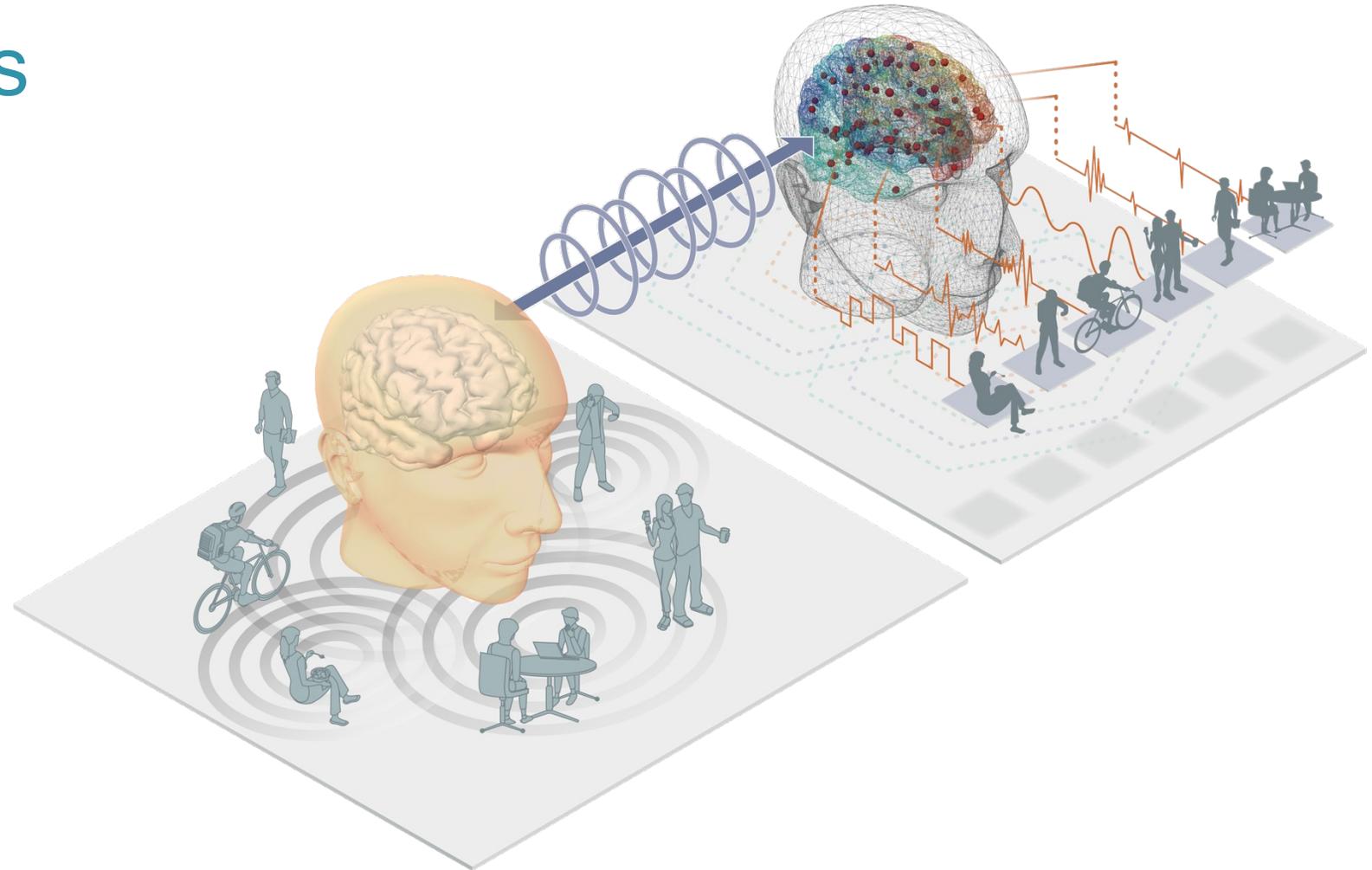
OUR GOAL

Digital Twins

Digital representation
of our knowledge & experiences
at a given level

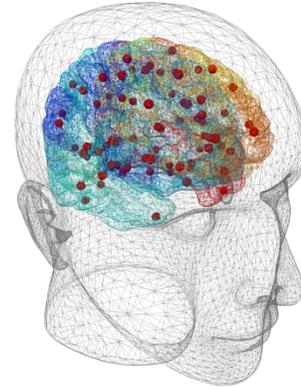
Fusion with empirical data

Autonomous simulation



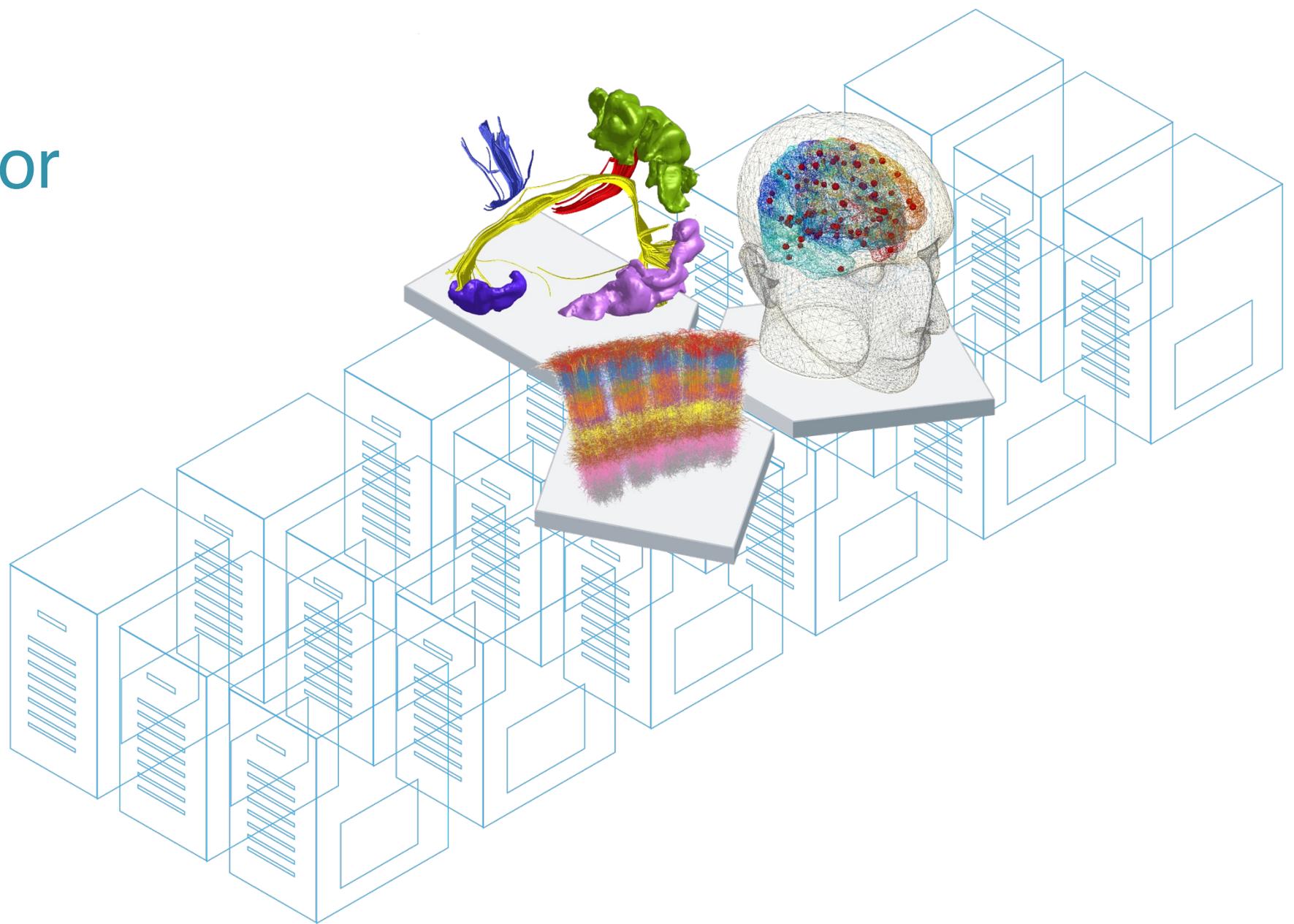
OUR GOAL

Building the Digital Twin Brain



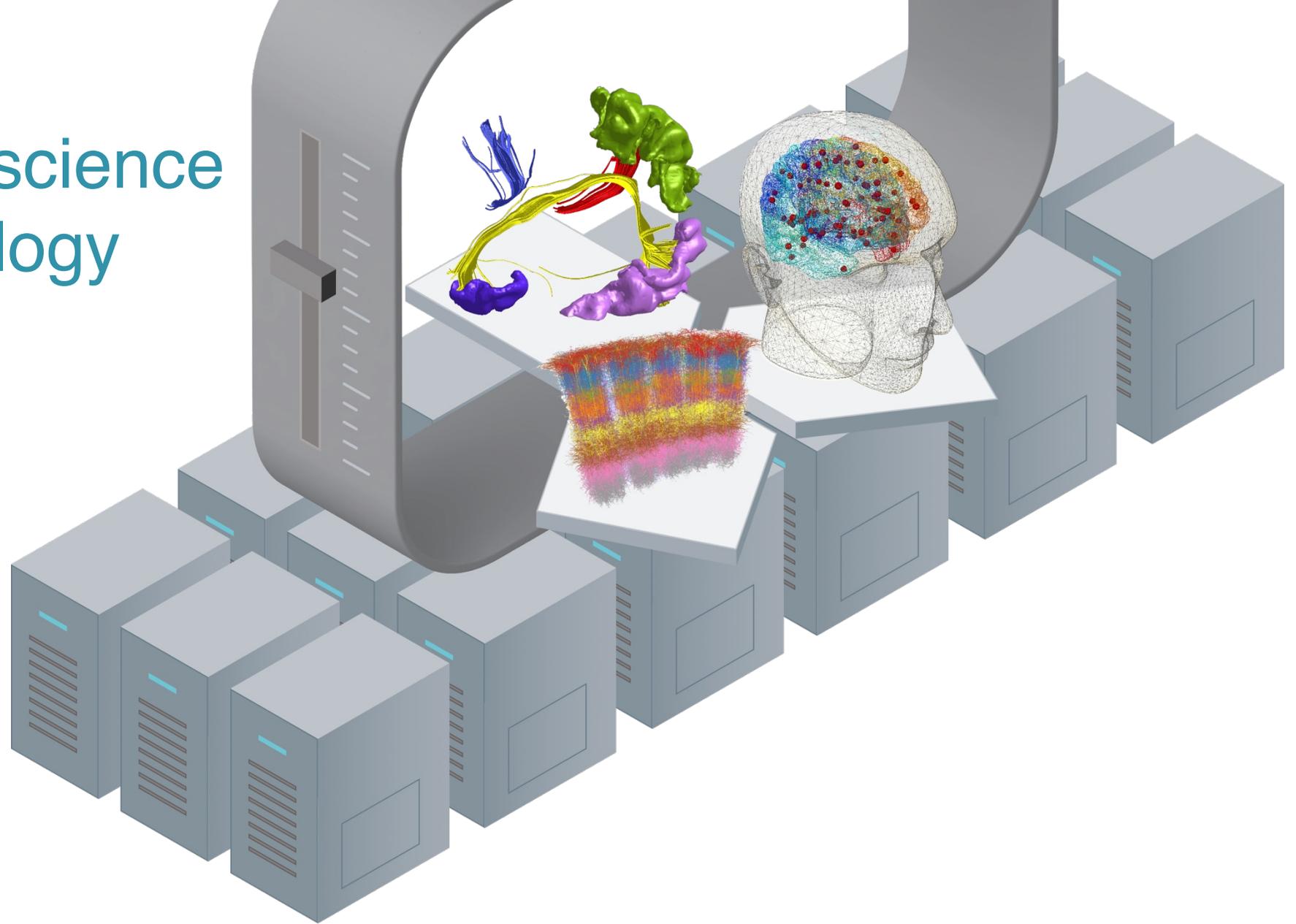
REQUIREMENTS

Support for multiple scales



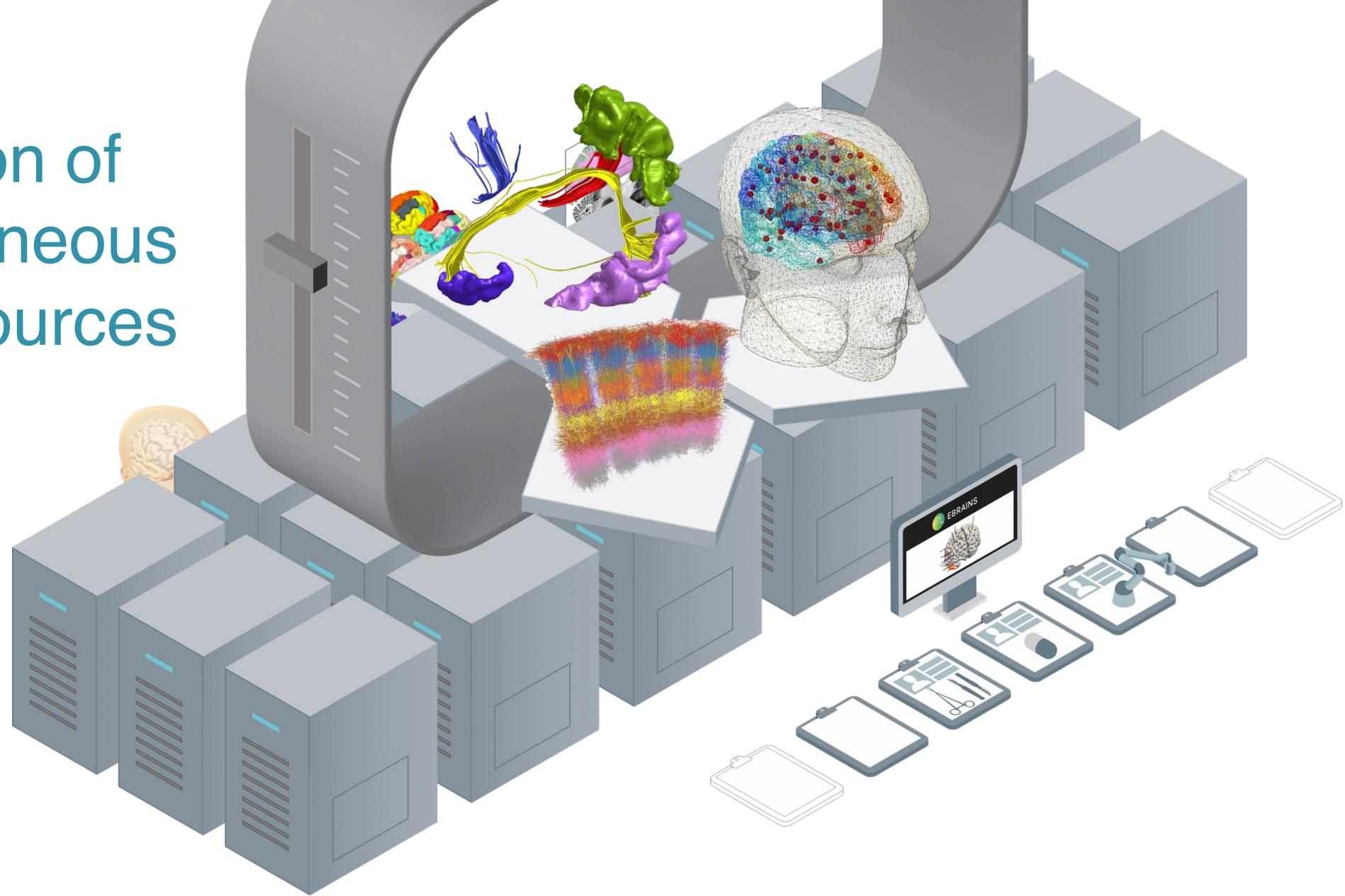
REQUIREMENTS

Merging science & technology



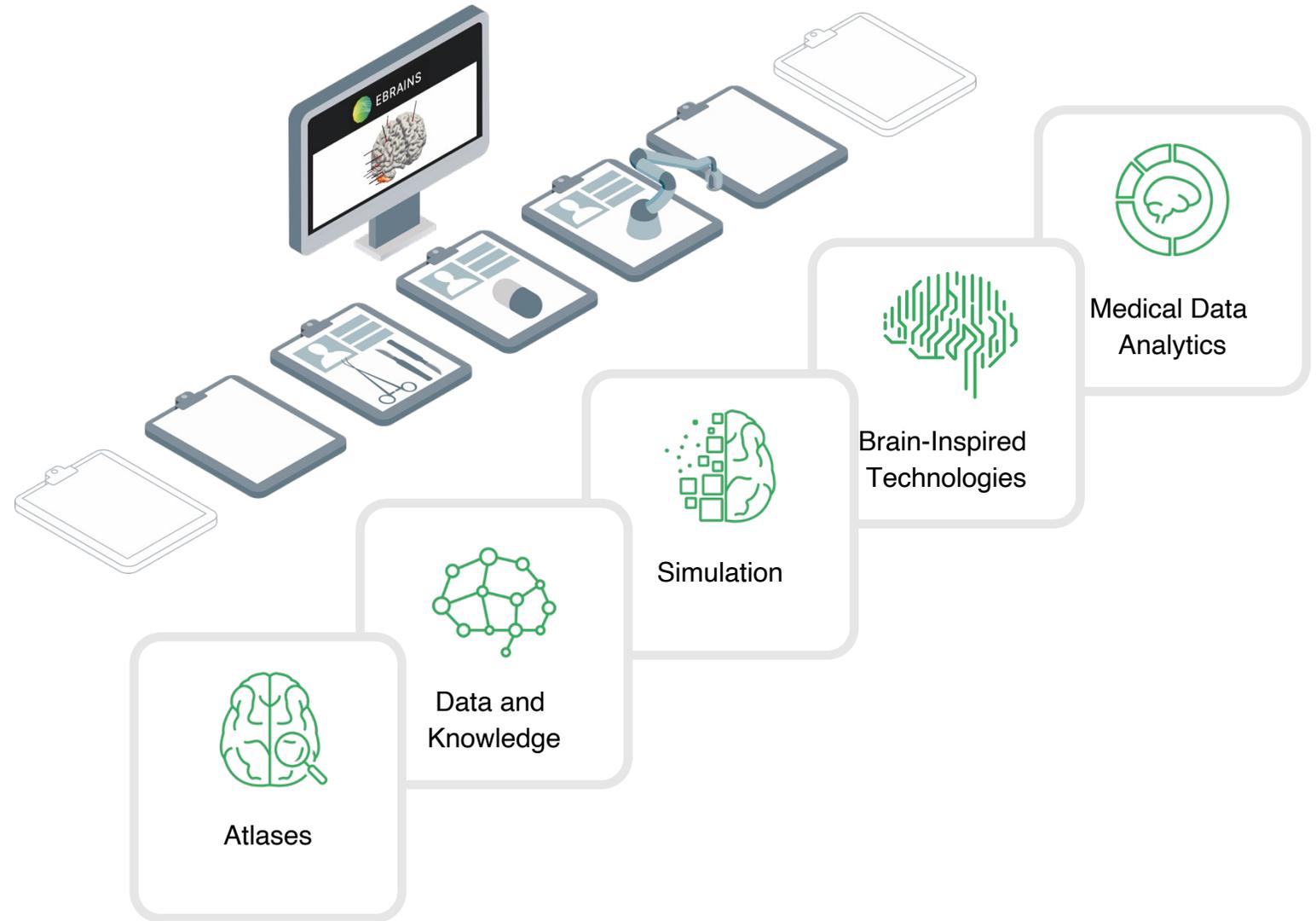
REQUIREMENTS

Integration of heterogeneous data & sources



A NEW PLATFORM

Co-designing EBRAINS



EBRAINS frontend

EBRAINS aims at **accelerating collaborative brain research** with a comprehensive package of data, tools and facilities.



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



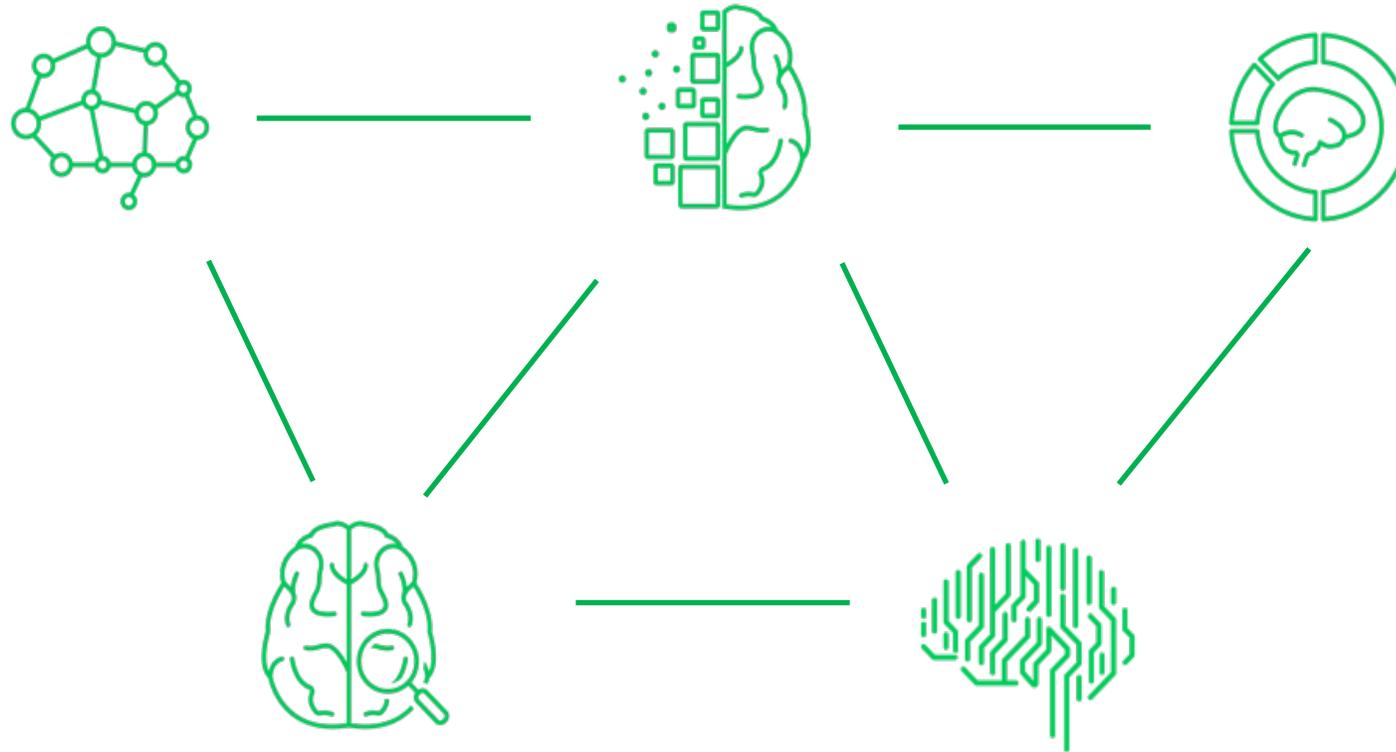
EBRAINS backend

Computing and Storage Services

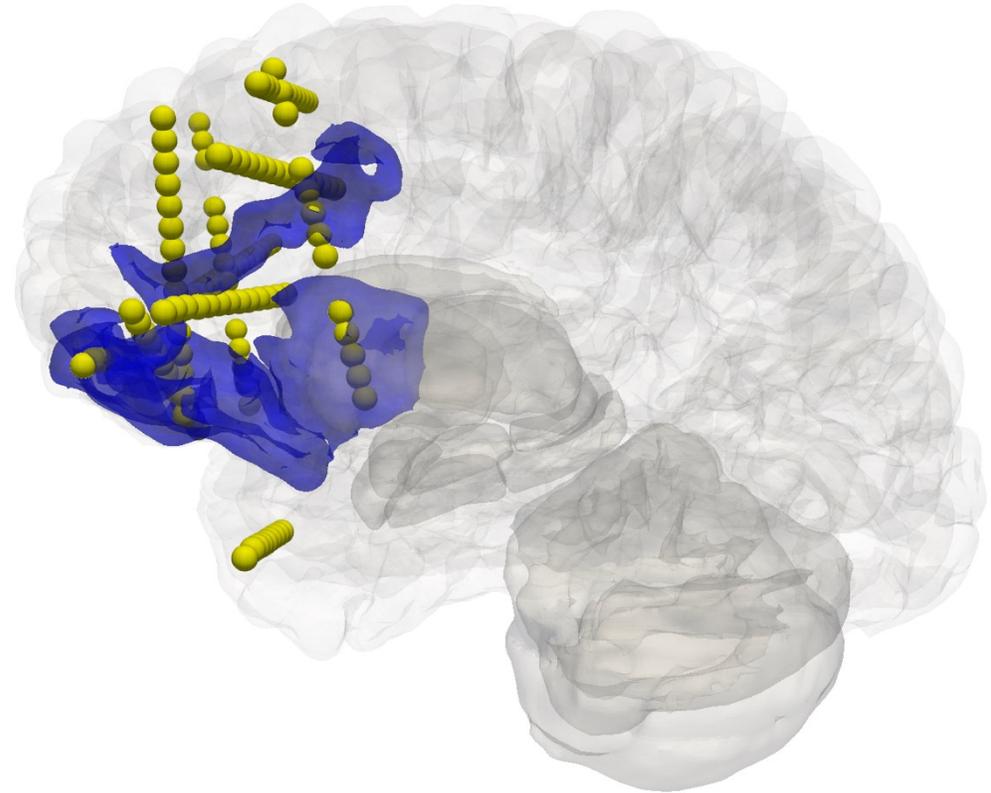
- Data and cloud services
 - For data sharing, collaborative research and service hosting
 - Training of large AI models for further data processing
- High-performance computing (HPC)
 - Processing and analysis of high-resolution data sets
 - Modelling and simulating large and complex neuronal network models
- HPC, Cloud and data services in close proximity and well-integrated



EBRAINS network of federated services



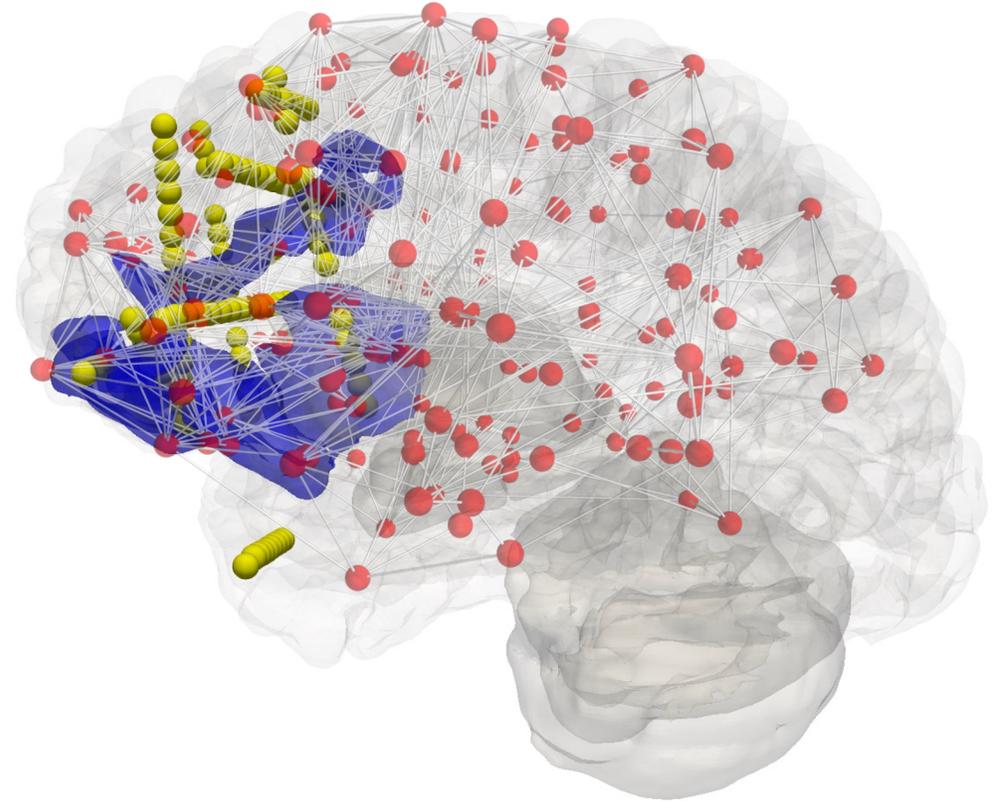
EBRAINS usecase: workflows in epilepsy



Blue: Clinical hypothesis for epileptogenic Zone (EZ)



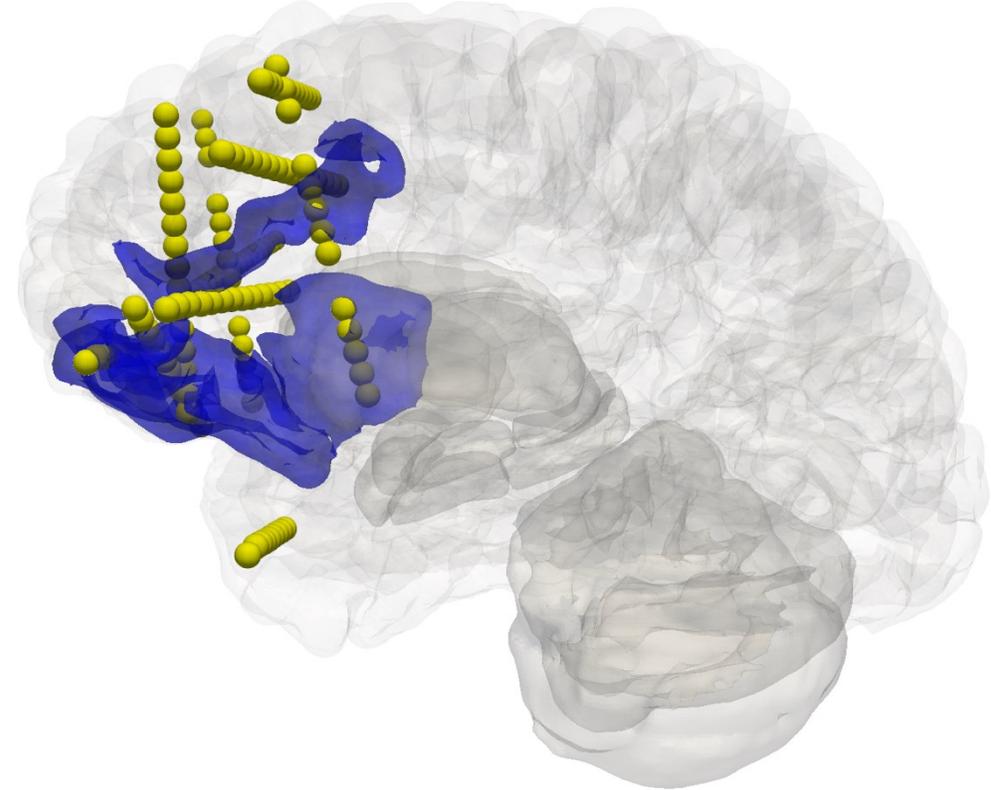
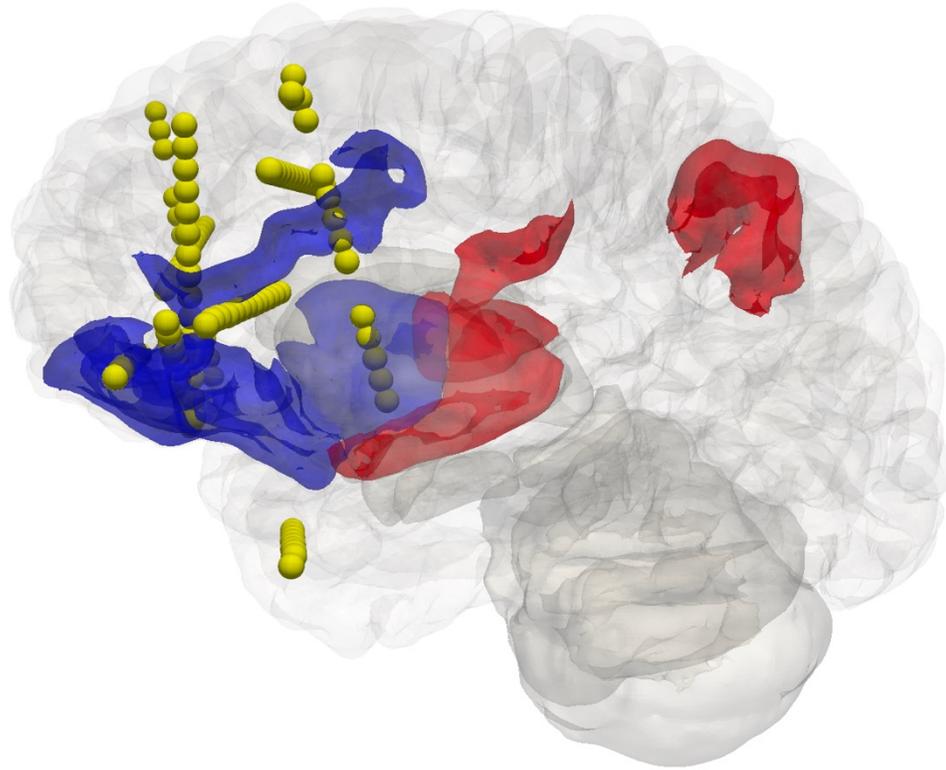
EBRAINS usecase: workflows in epilepsy



Blue: Clinical hypothesis for epileptogenic Zone (EZ)



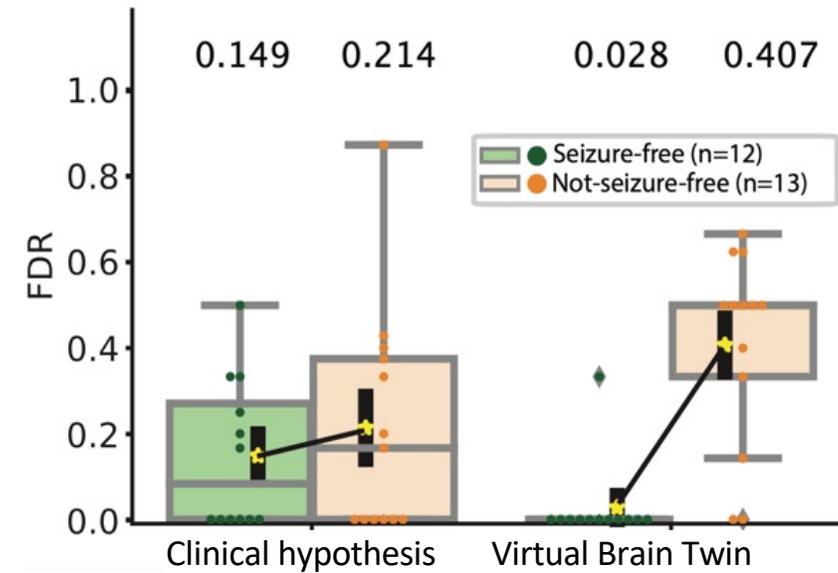
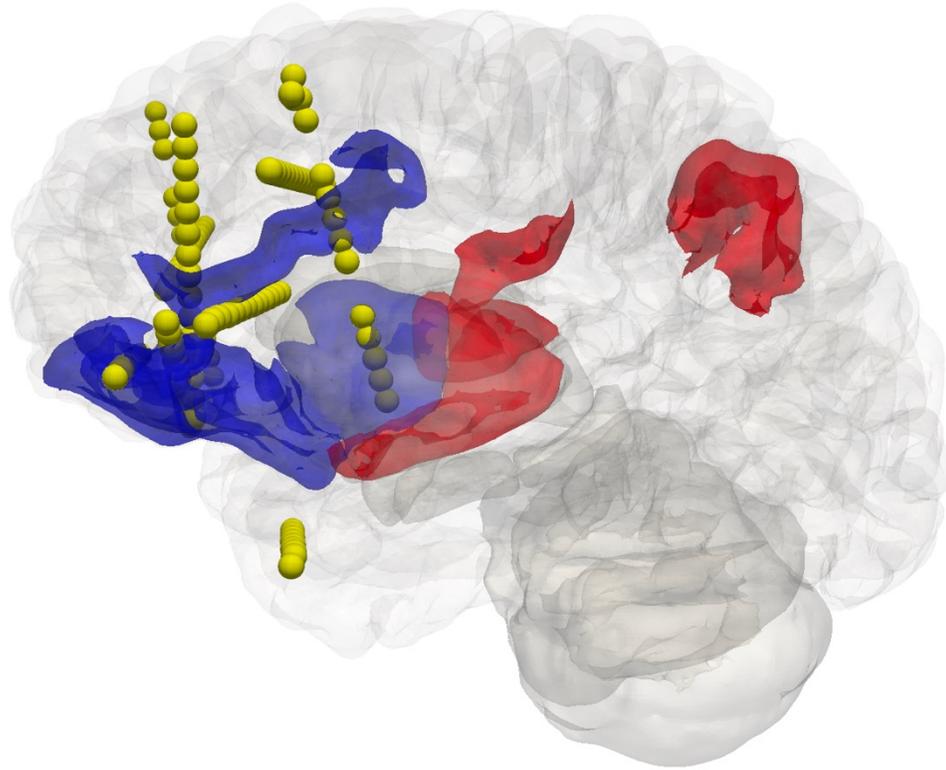
EBRAINS usecase: workflows in epilepsy



Blue: Clinical hypothesis for epileptogenic Zone (EZ)
Red: Additional EZ brain areas by virtual brain



EBRAINS usecase: retrospective data in epilepsy



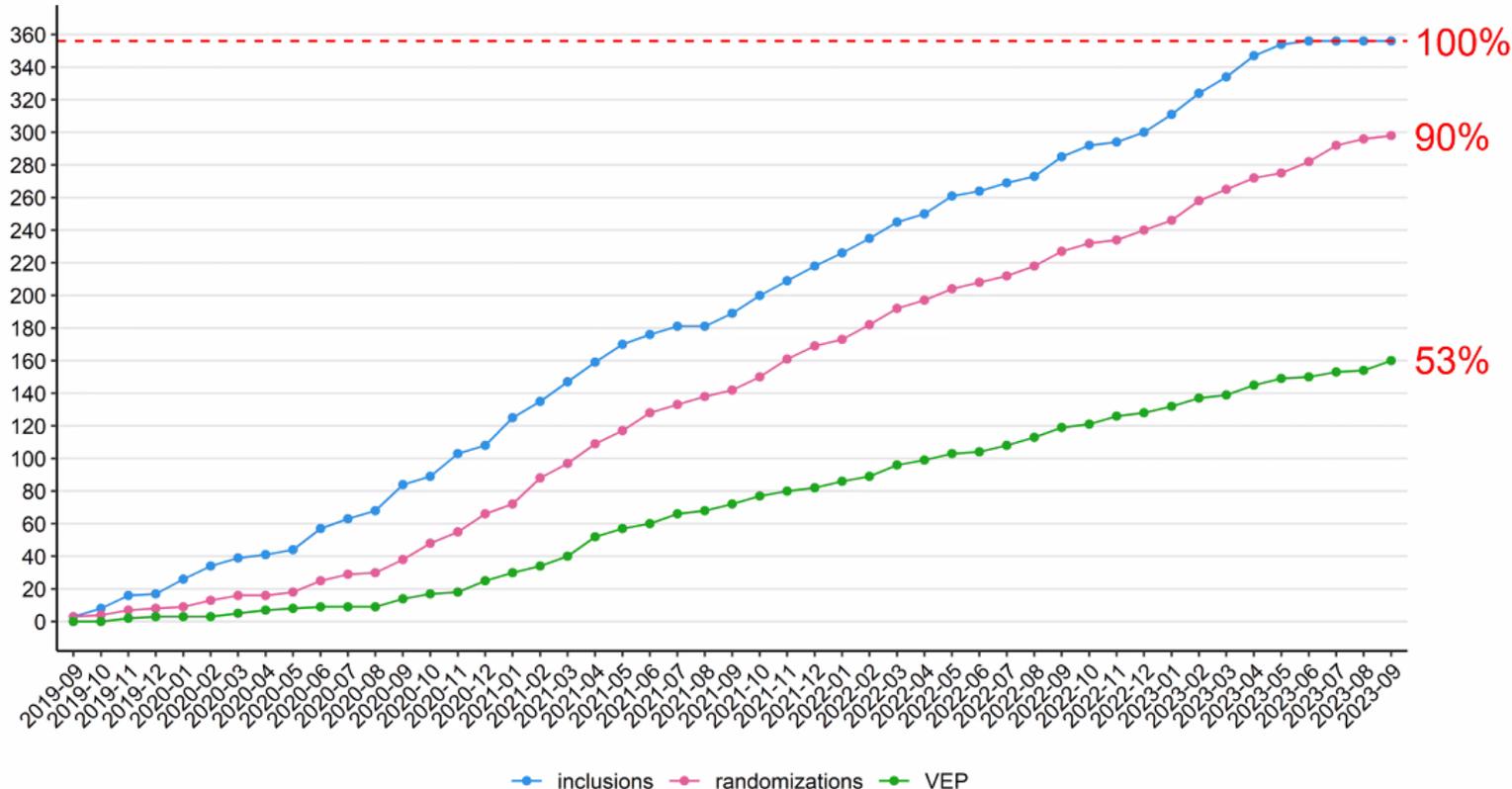
29% of all cases fall in the red EZ areas and are not accessible via SEEG

Blue: Clinical hypothesis for epileptogenic Zone (EZ)
Red: Additional EZ brain areas by virtual brain

EBRAINS usecase: prospective clinical trial



Evolution of the number of inclusions, randomizations and VEP reports



Clinical trial: NCT03643016
Sponsor : Assistance publique - Hôpitaux de Marseille
Trial duration: 2019 - 2023

356 patients included
298 patients randomized (149 VEP and 149 control)
160 VEP reports sent (133 VEP and 27 control)
178 surgeries performed (93 VEP and 85 control)





**VIRTUAL
BRAIN
TWIN**

A VIRTUAL BRAIN FOR EVERY PATIENT.

Coordinator: EBRAINS

UNIVERSITE D'AIX MARSEILLE
CHARITE
KUNGLIGA TEKNISKA HOEGSKOLAN
LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN
UNIVERSITEIT VAN AMSTERDAM
UNIVERSITA DEGLI STUDI DI PAVIA
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
FORSCHUNGSZENTRUM JULICH GMBH
UNIVERSIDAD POLITECNICA DE MADRID
CODEMART SRL
UNIVERSIDAD REY JUAN CARLOS
RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAT BONN
CENTRE HOSPITALIER REGIONAL DE MARSEILLE ASSISTANCE PUBLIQUE-
HOPITAUX MARSEILLE
ATHENA
EUROPESE FEDERATIE VAN FAMILIEVERENIGINGEN VAN PSYCHIATRISCH
ZIEKE PERSONENIVZW
GLOBAL ALLIANCE OF MENTAL ILLNESS ADVOCACY NETWORKS EUROPE
ASSOCIATION EUROPEENNE DE PSYCHIATRIE

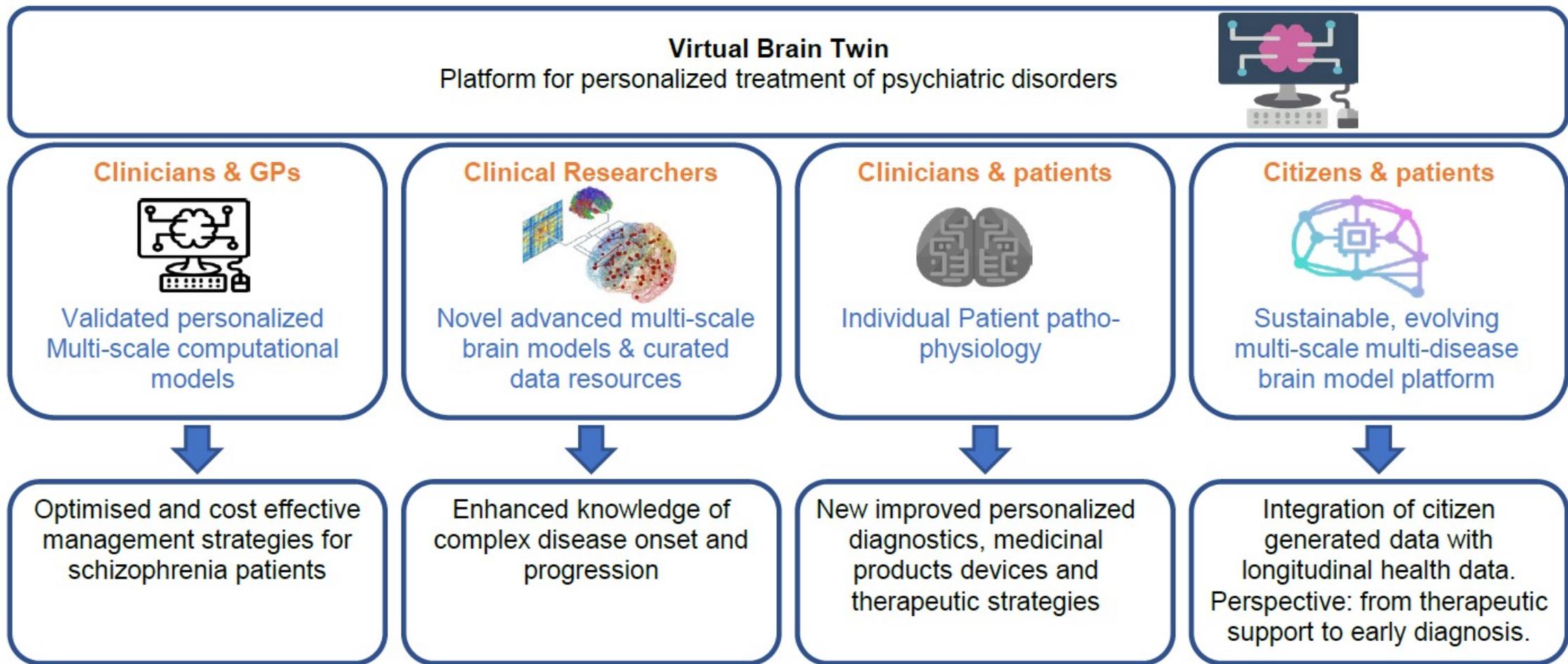
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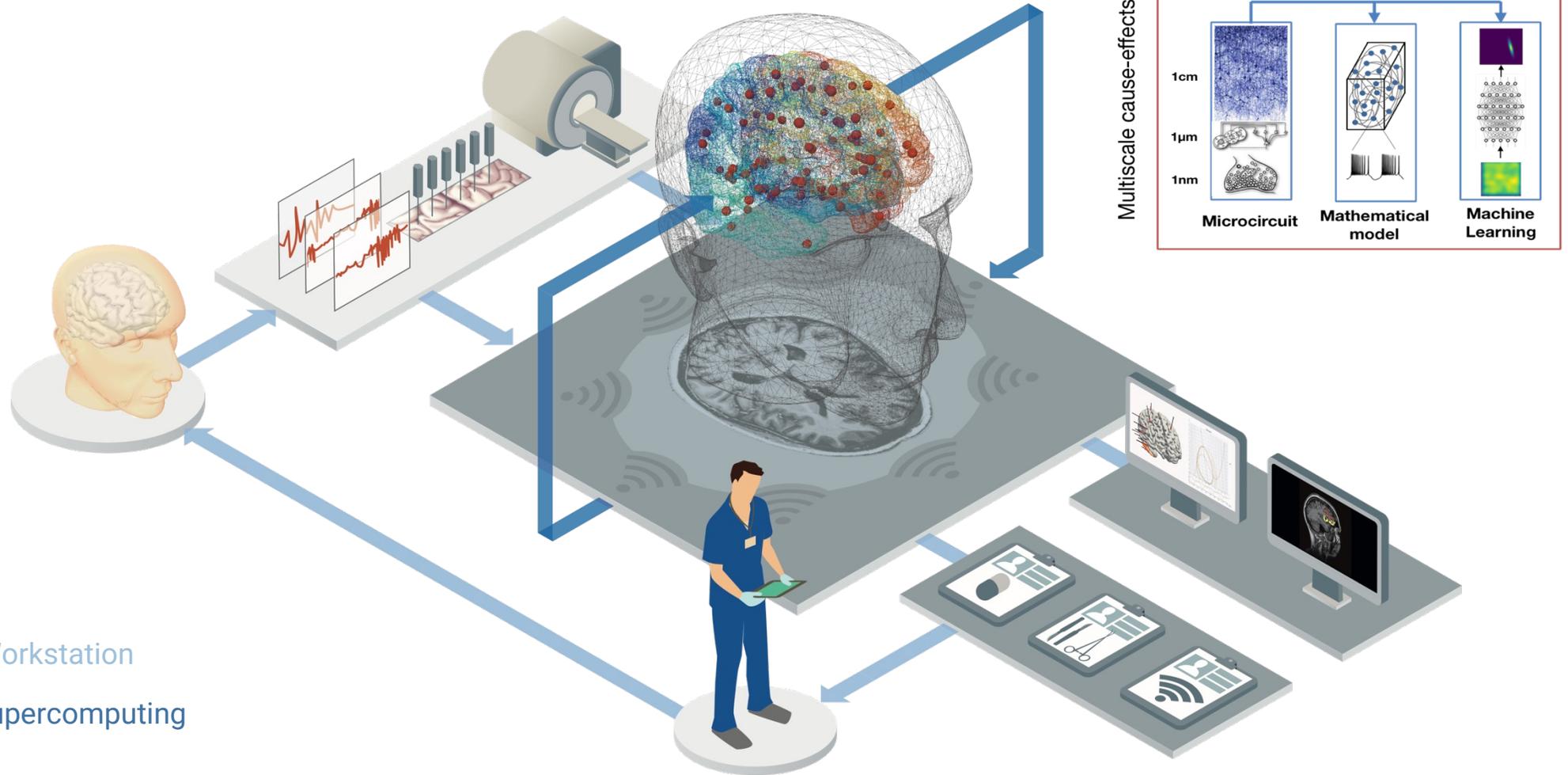
Co-funded by
the European Union

January 2024 – December 2027

Beneficiaries
Products
Outcomes



The Virtual Brain Twin concept



The Virtual Brain Twin approach

Two clinical studies

1. **PROMISE** (ongoing randomized clinical trial). Each patient's brain will be personalised using VBT.
2. **MOPSYPHAR**, will evaluate the final tool's implementation, clinical utility and ethical acceptability.

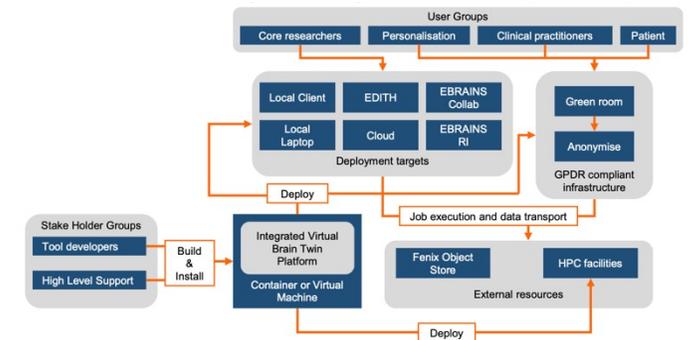
Computational brain medicine

Each **VBT module** can be performed in isolation, but exchanges information across modules.

- **Traversing scales module** : passing cause-effect across scales
- **Virtual brain module**: personalised brain network simulations and brain health assessment

Integration of research and clinical platforms

The assembly of the VBT will form the centre of the ecosystem through the participation of user groups and stakeholders and incorporation of new data, developed within EBRAINS-RI and other projects





Human Brain Project



EBRAINS

Thank you

