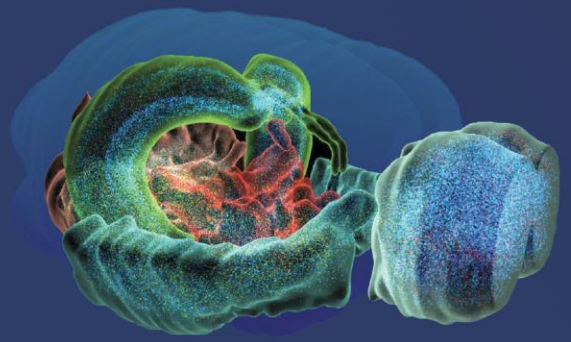
EPFL

Blue Brain Project



Digitally reconstructing and
simulating the mouse brain

EPFL

Blue Brain Project

EPFL's Blue Brain Project is a Swiss brain research Initiative led by Founder and Director Professor Henry Markram.

The aim of Blue Brain is to establish simulation neuroscience as a complementary approach alongside experimental, theoretical and clinical neuroscience to understanding the brain, by building the world's first biologically detailed digital reconstructions and simulations of the mouse brain.

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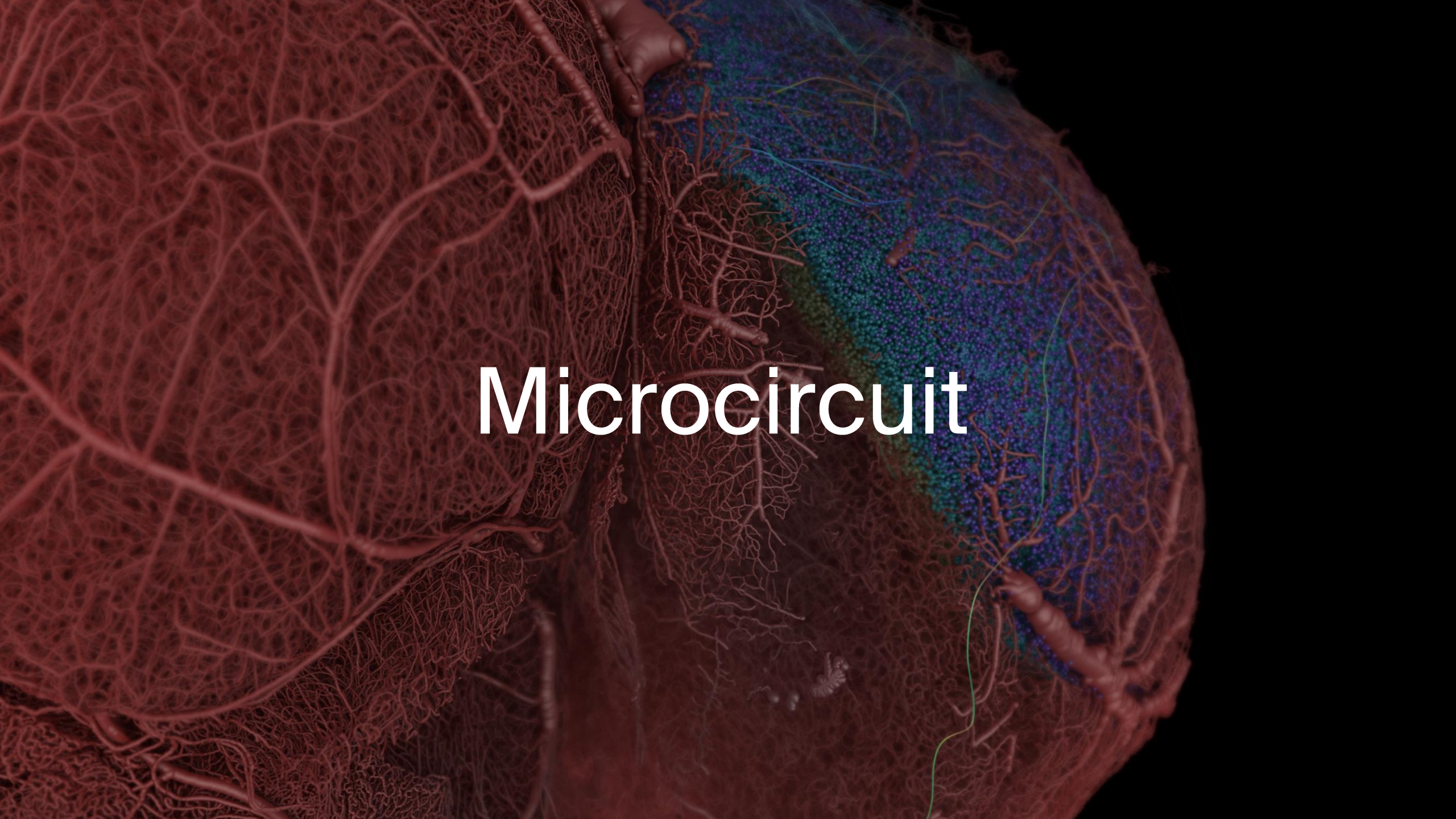
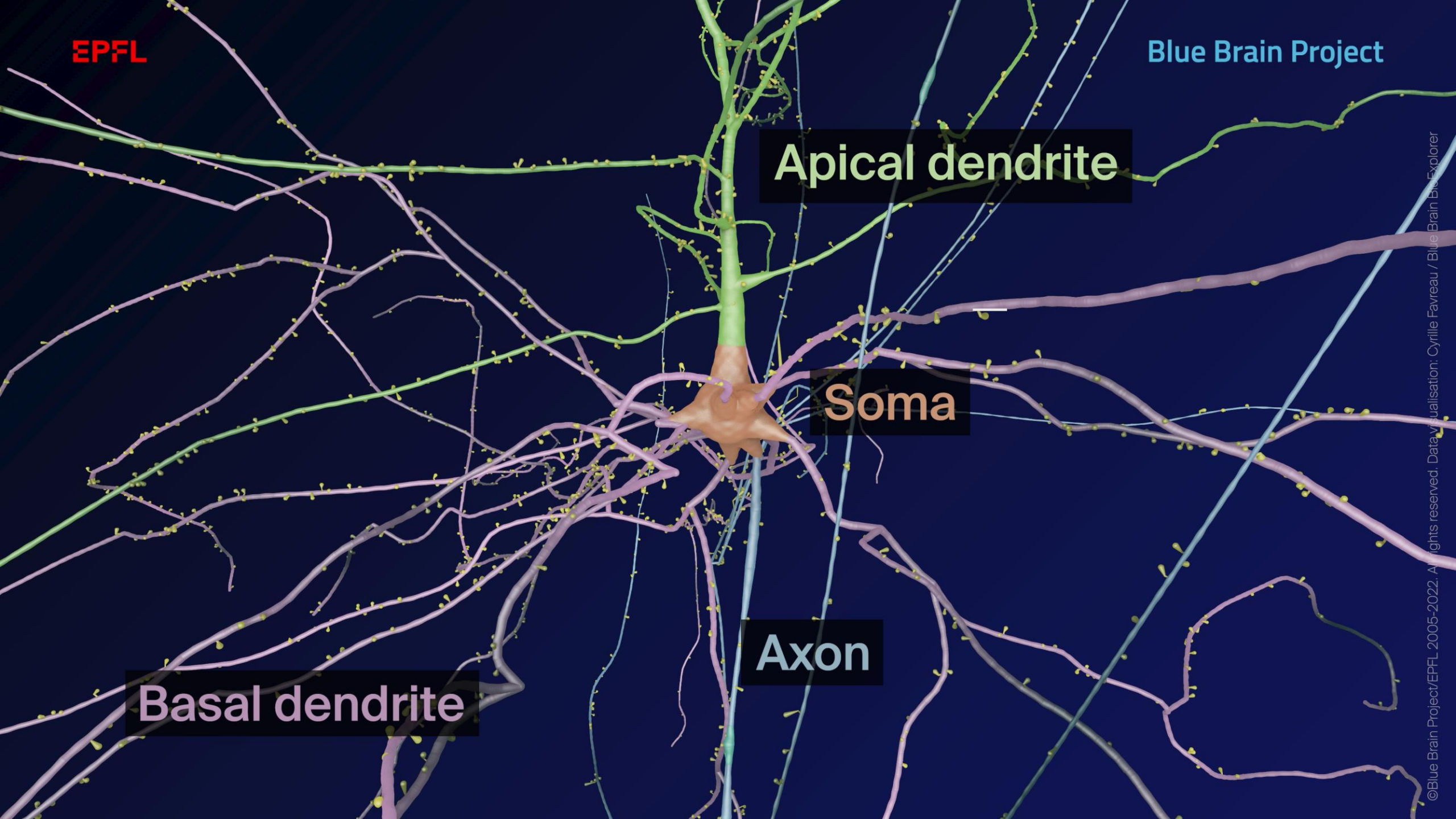

Microcircuit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Blue Brain Project
Apical dendrite
Soma
Axon
Basal dendrite
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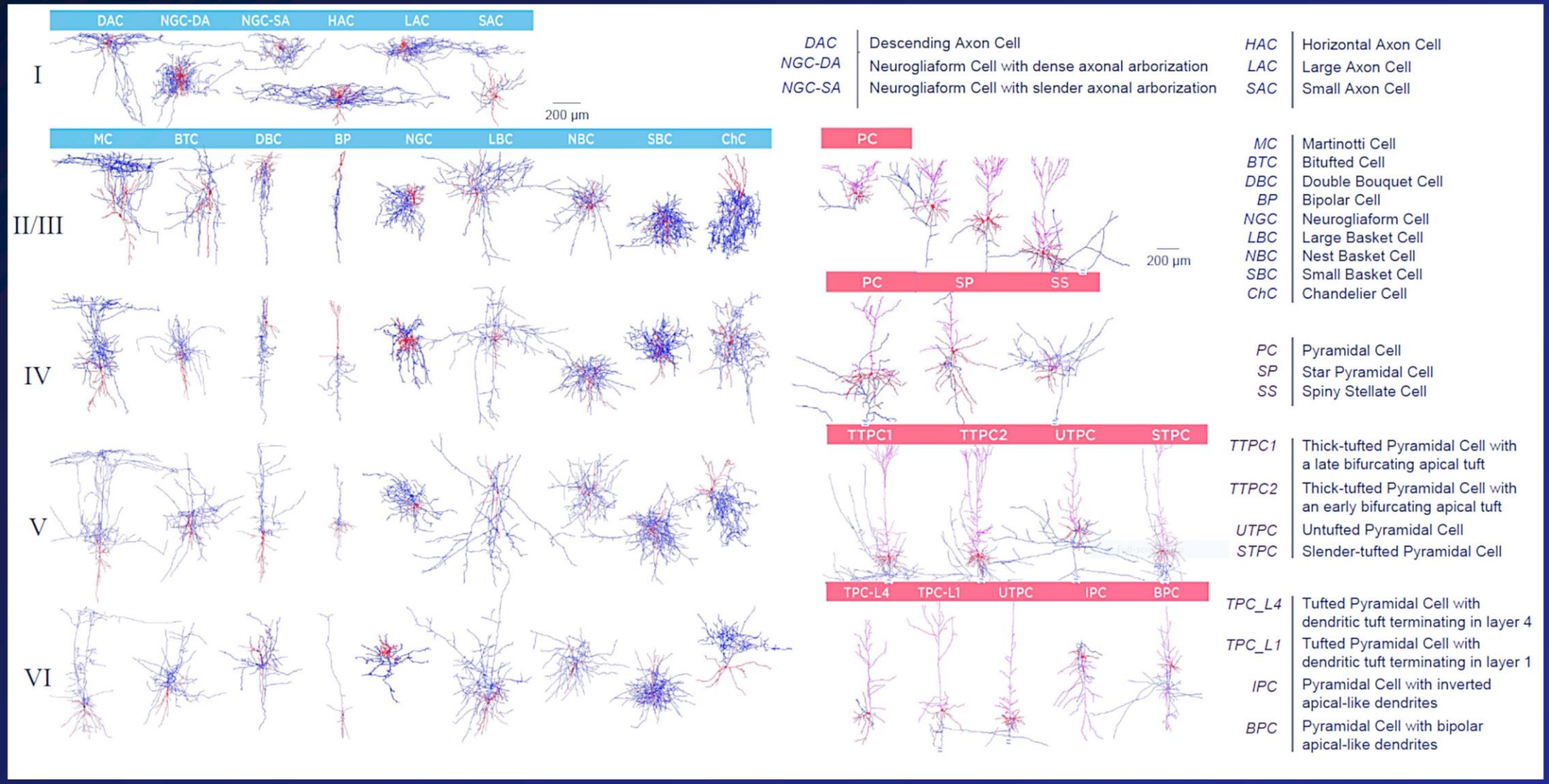

DAC	Descending Axon Cell
NGC-DA	Neurogliaform Cell with dense axonal arborization
NGC-SA	Neurogliaform Cell with slender axonal arborization
HAC	Horizontal Axon Cell
LAC	Large Axon Cell
SAC	Small Axon Cell

MC	Martinotti Cell
BTC	Bitufted Cell
DBC	Double Bouquet Cell
BP	Bipolar Cell
NGC	Neurogliaform Cell
LBC	Large Basket Cell
NBC	Nest Basket Cell
SBC	Small Basket Cell
ChC	Chandelier Cell

PC	Pyramidal Cell
SP	Star Pyramidal Cell
SS	Spiny Stellate Cell

TTPC1	Thick-tufted Pyramidal Cell with a late bifurcating apical tuft
TTPC2	Thick-tufted Pyramidal Cell with an early bifurcating apical tuft
UTPC	Untufted Pyramidal Cell
STPC	Slender-tufted Pyramidal Cell

TPC_L4	Tufted Pyramidal Cell with dendritic tuft terminating in layer 4
TPC_L1	Tufted Pyramidal Cell with dendritic tuft terminating in layer 1
IPC	Pyramidal Cell with inverted apical-like dendrites
BPC	Pyramidal Cell with bipolar apical-like dendrites

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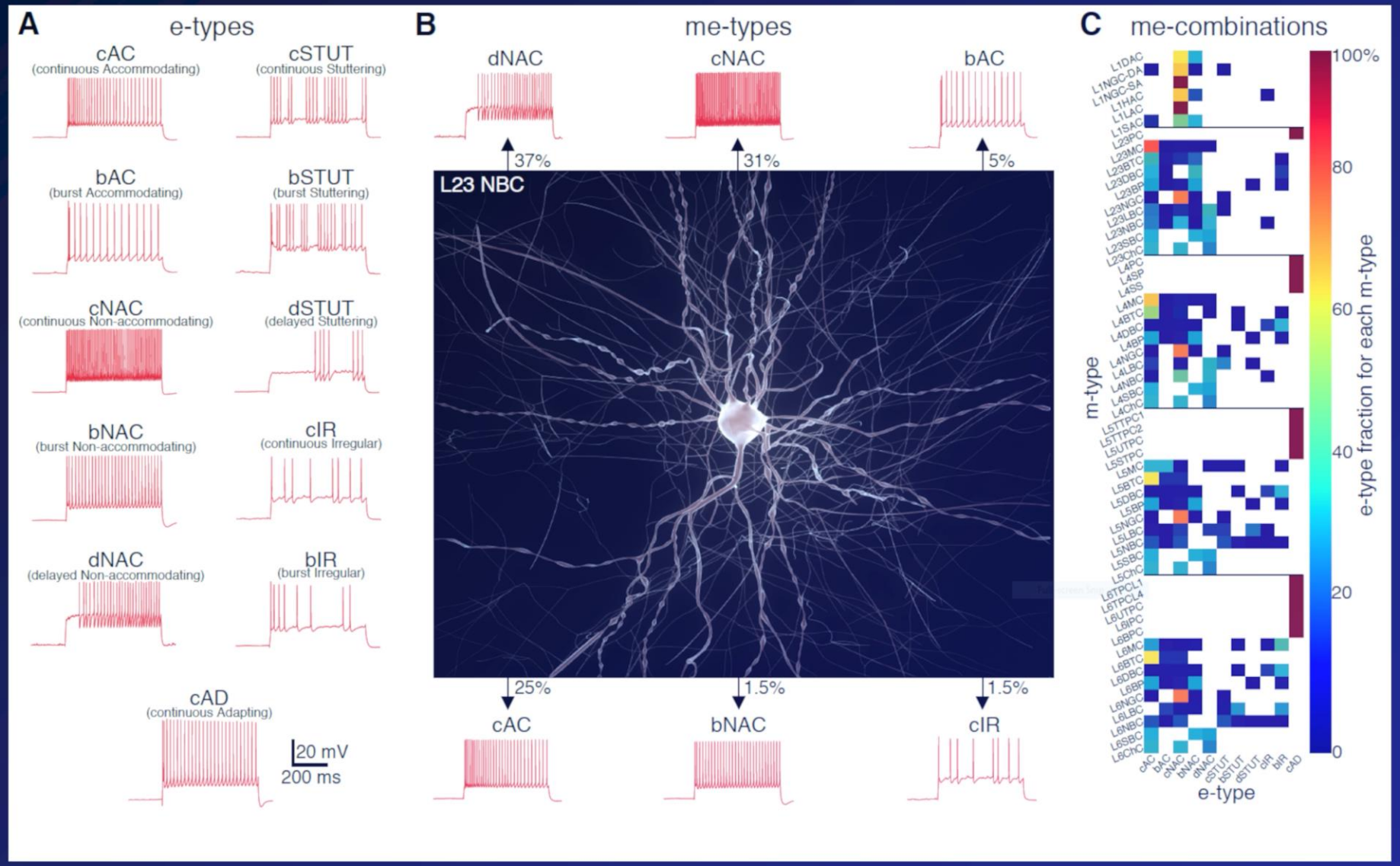

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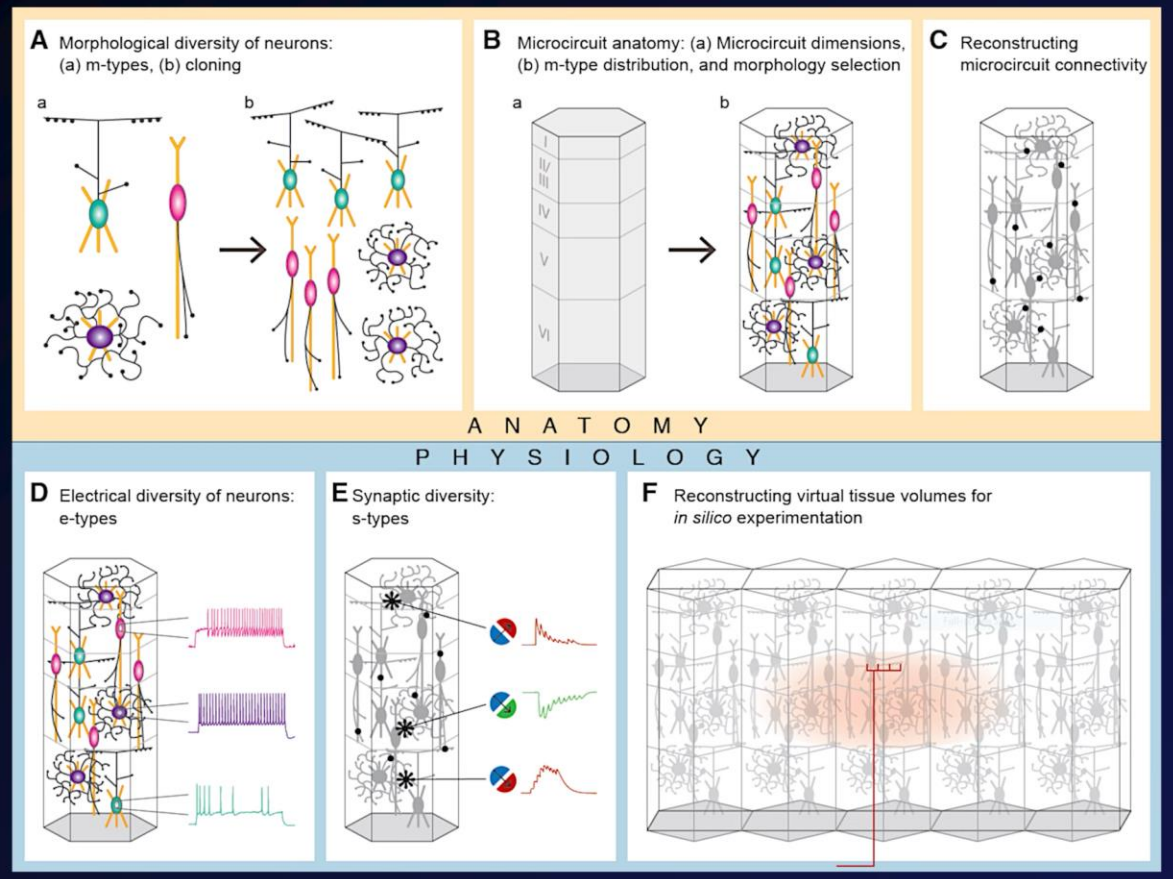

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Brain regions

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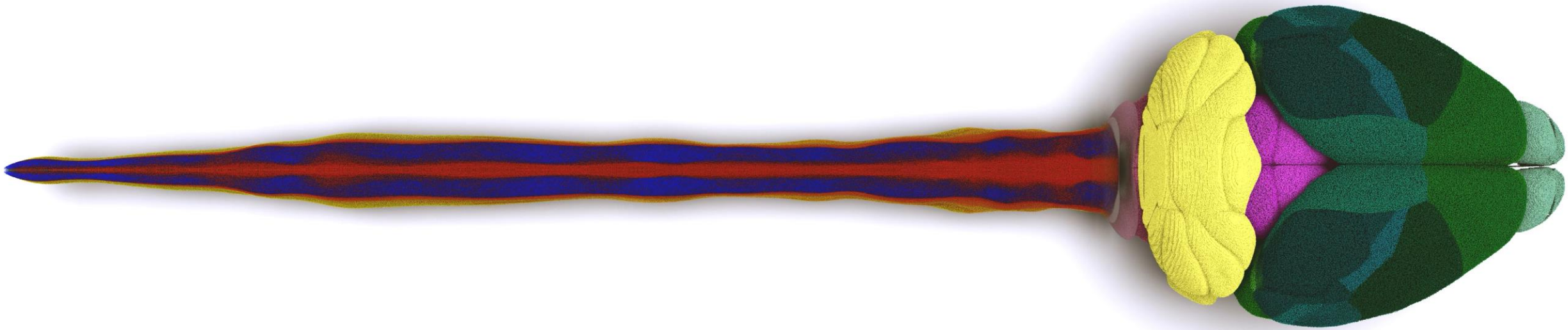

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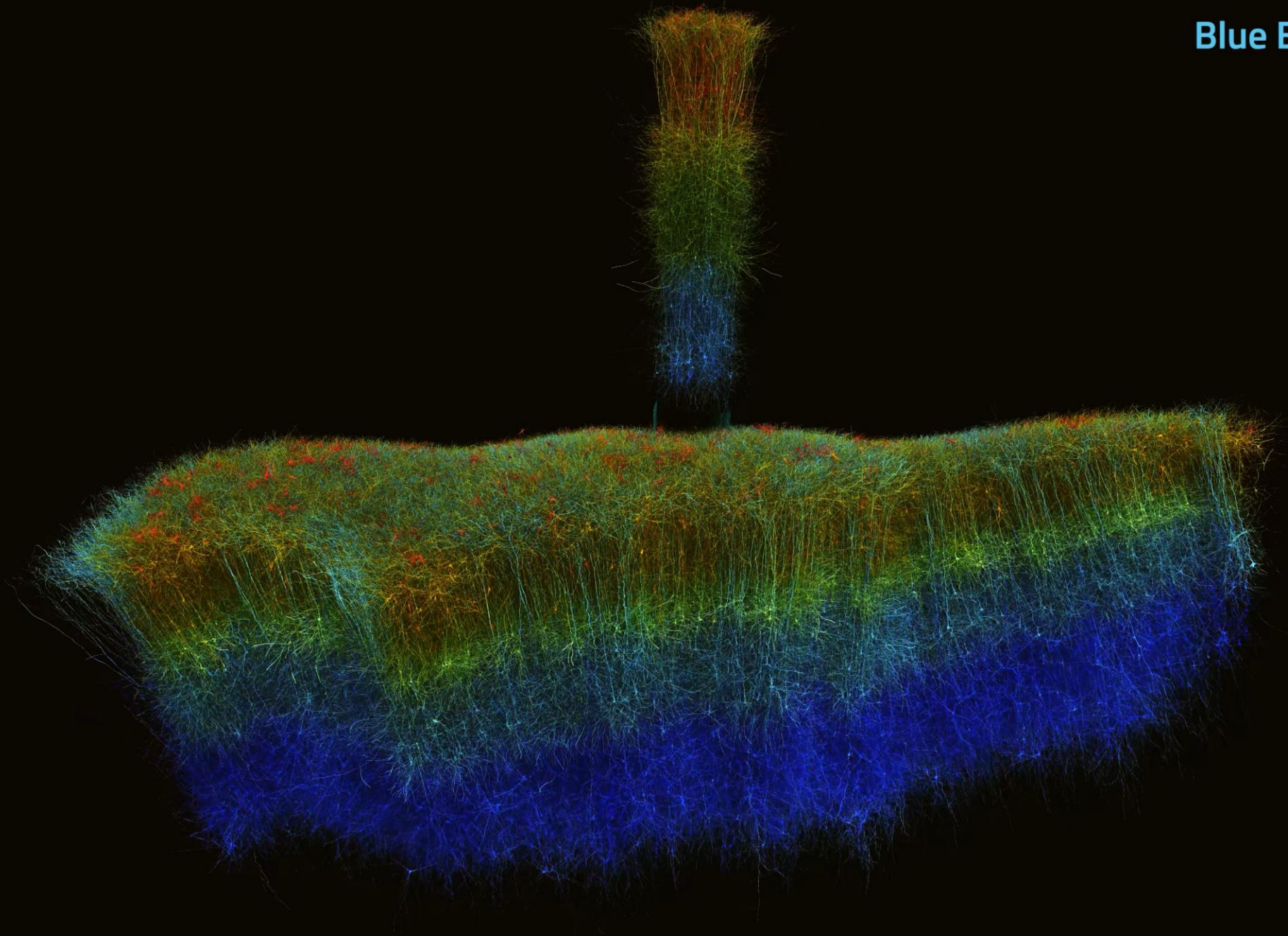

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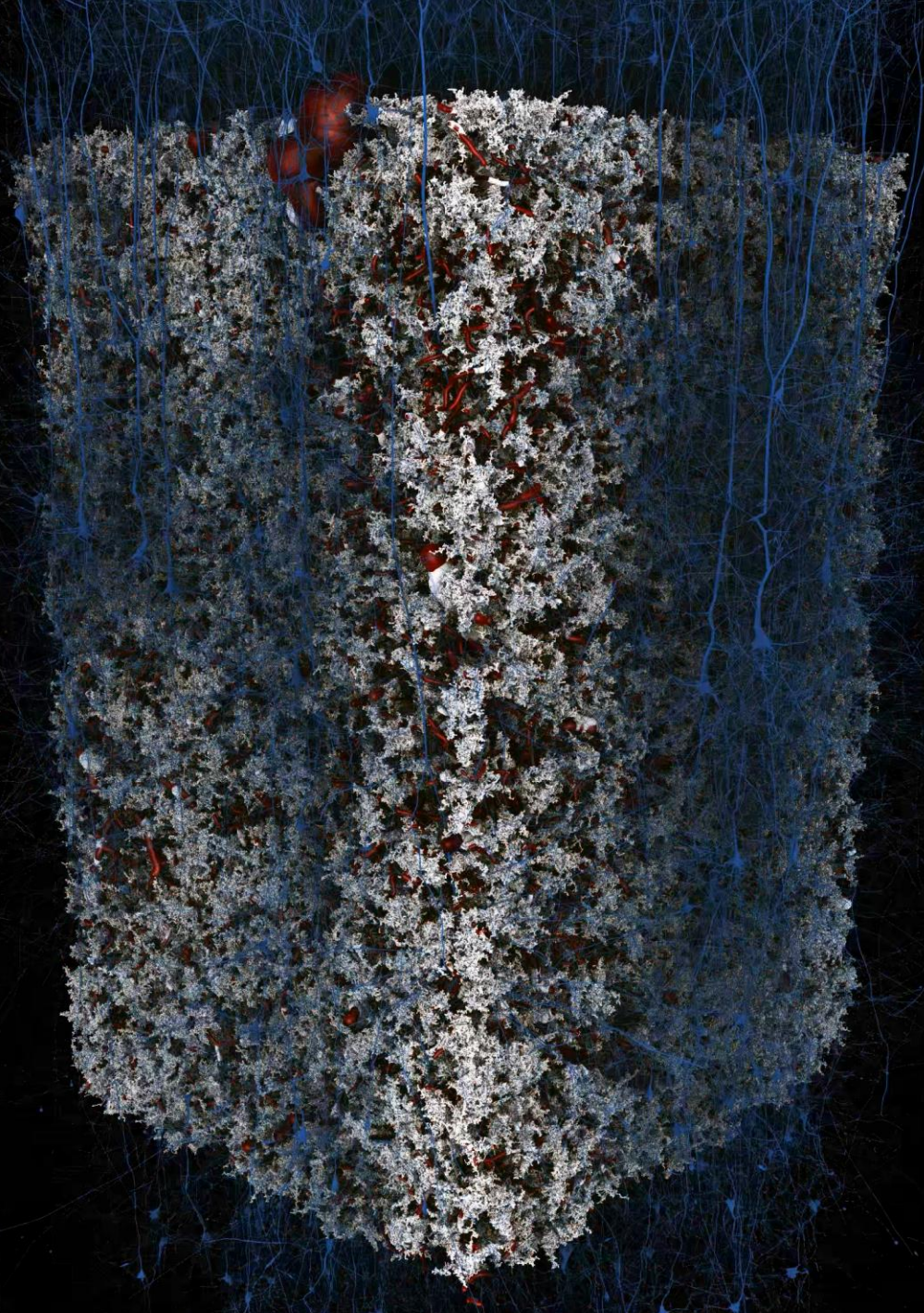

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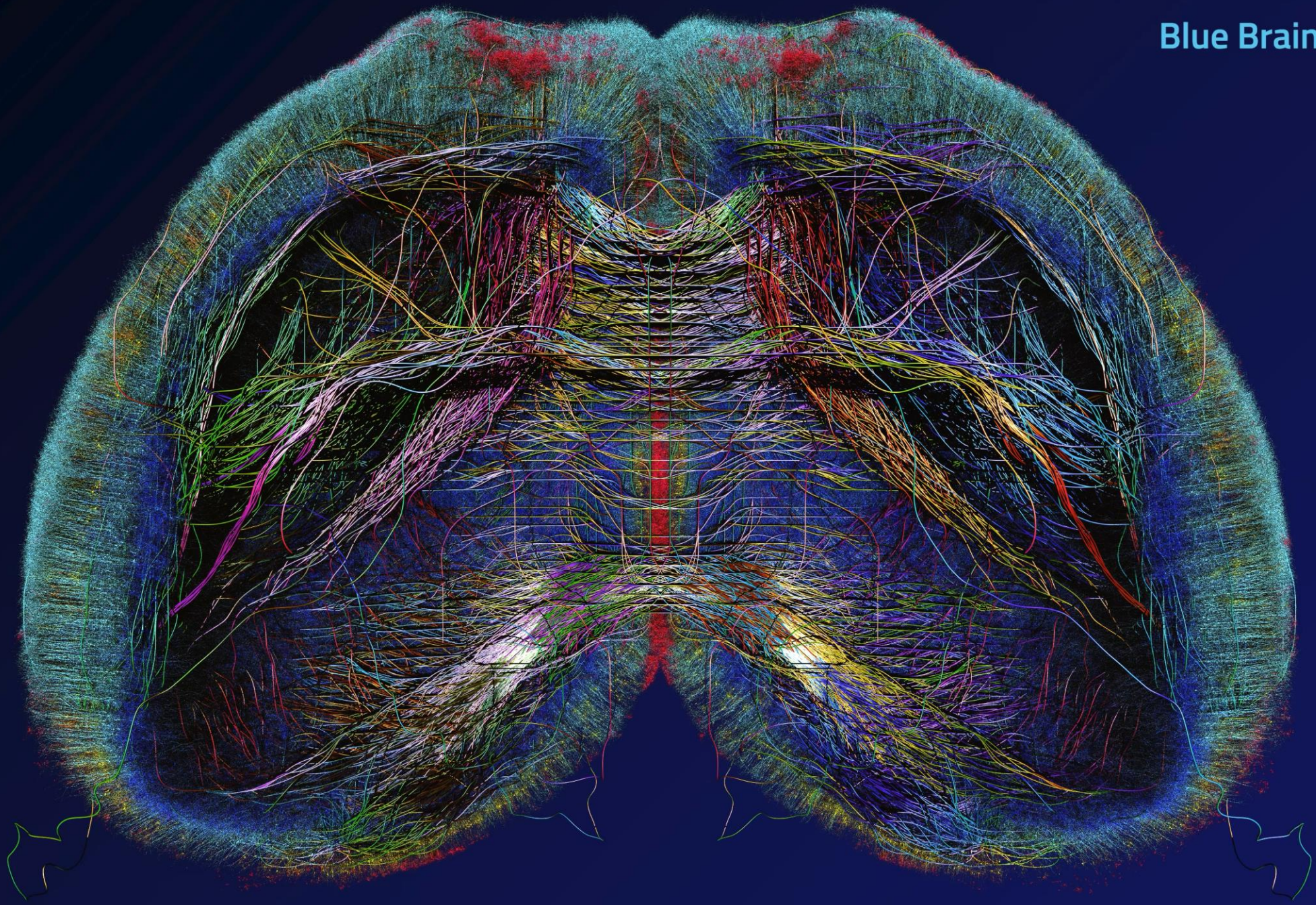

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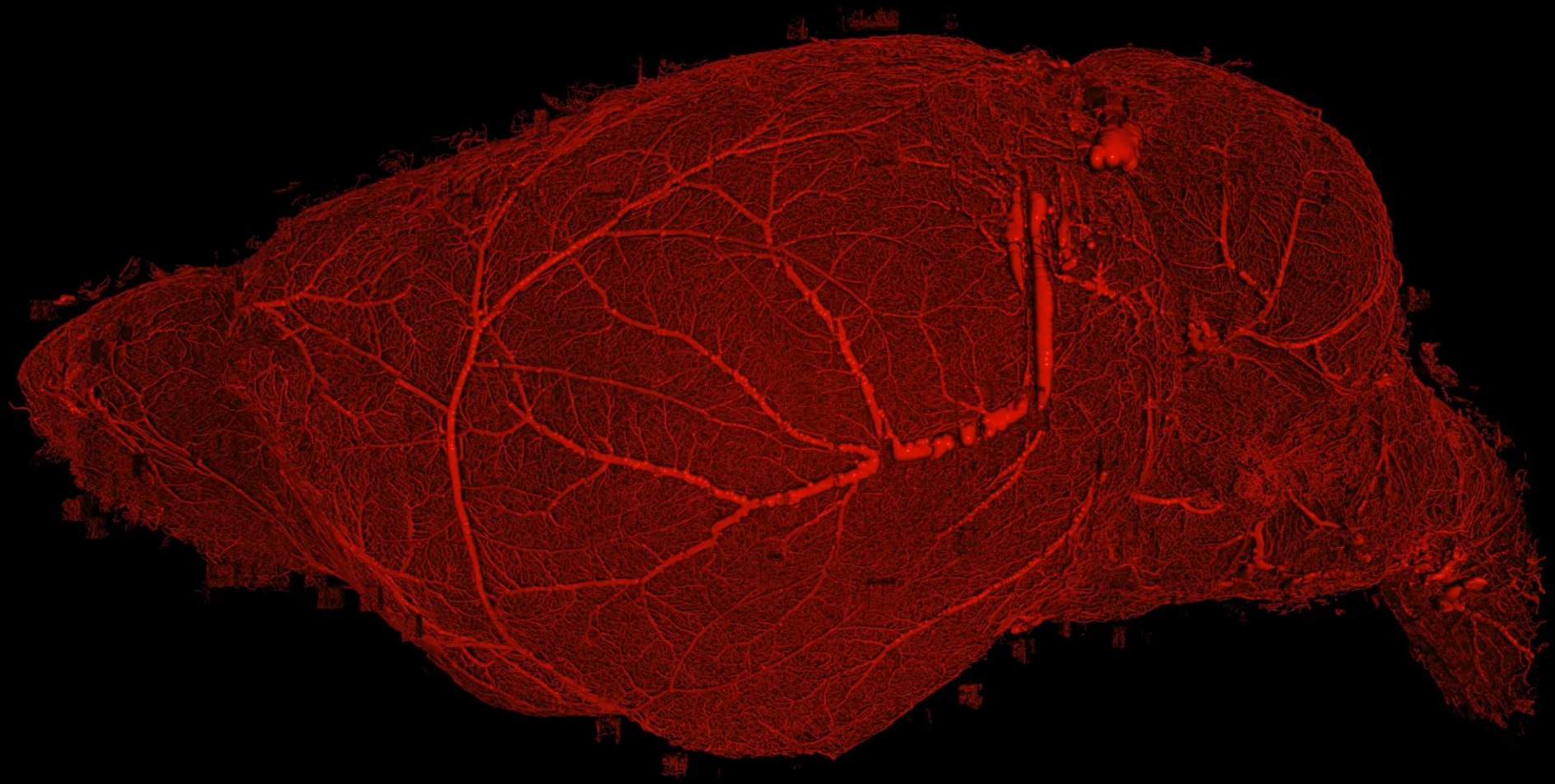

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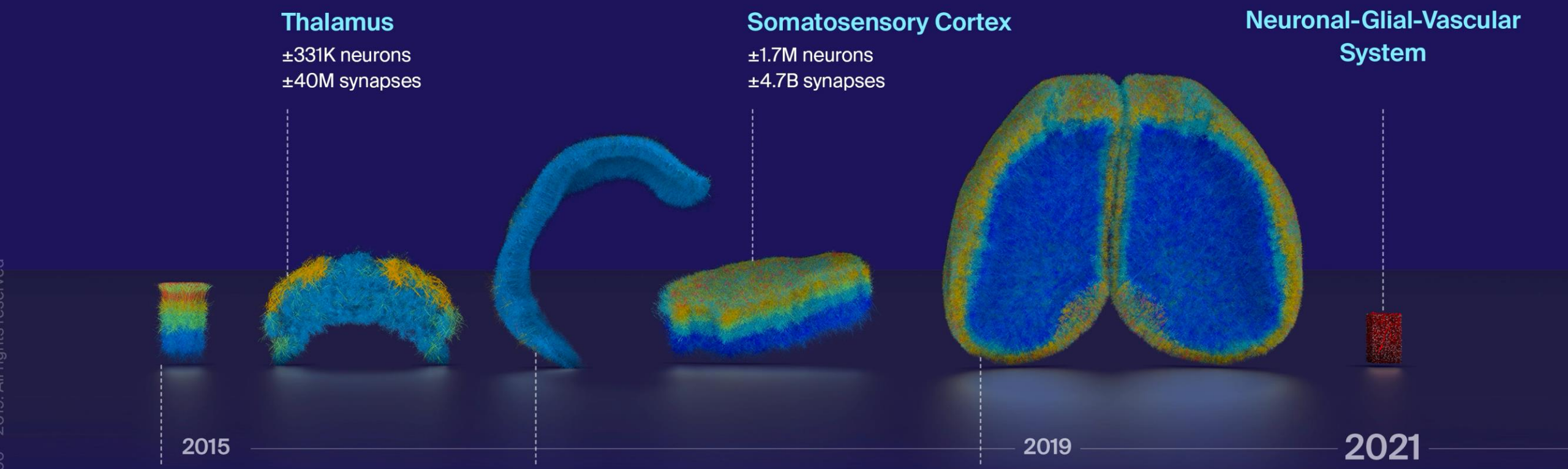

Digitally reconstructing and simulating the brain

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Brain simulation

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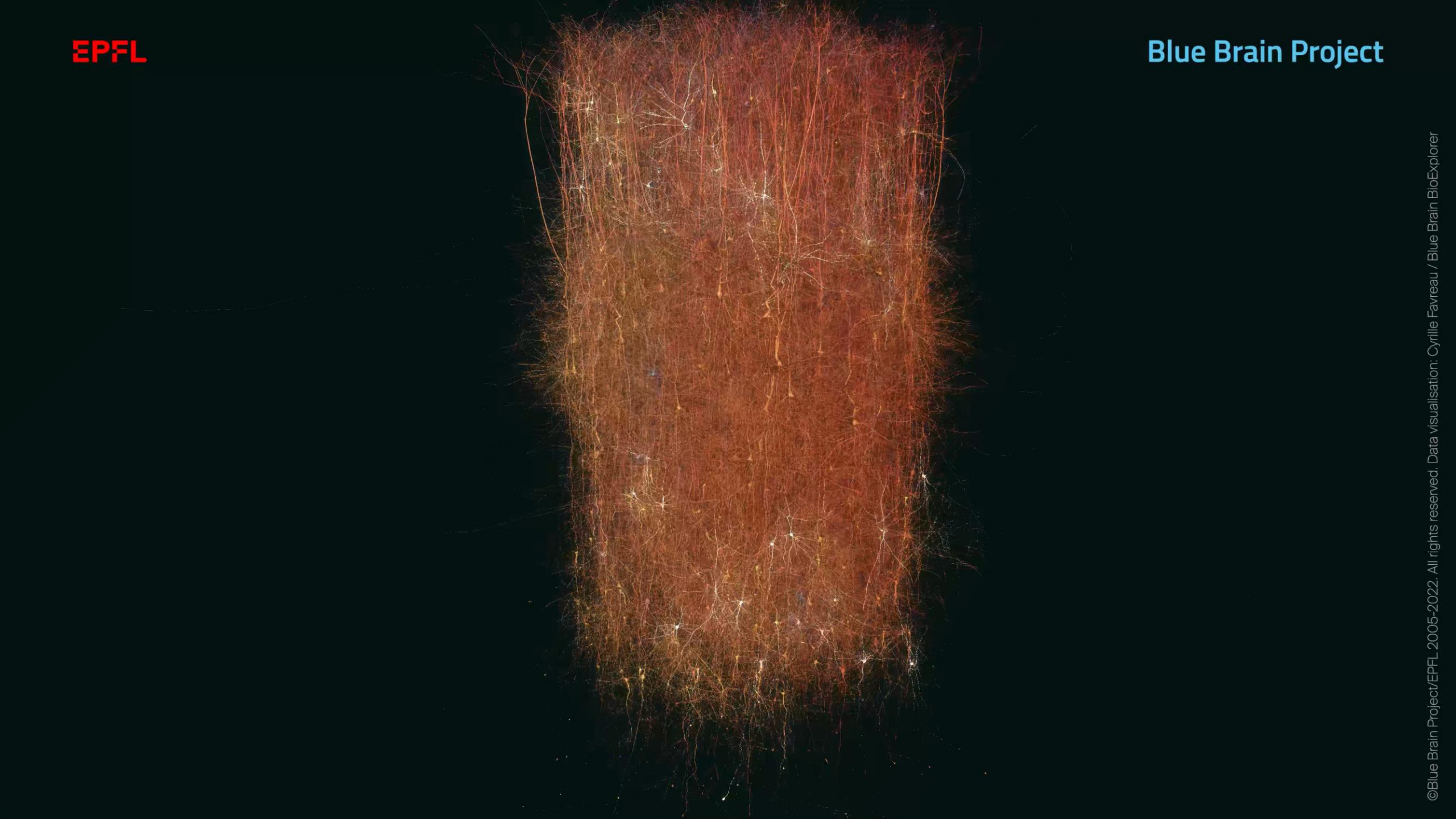

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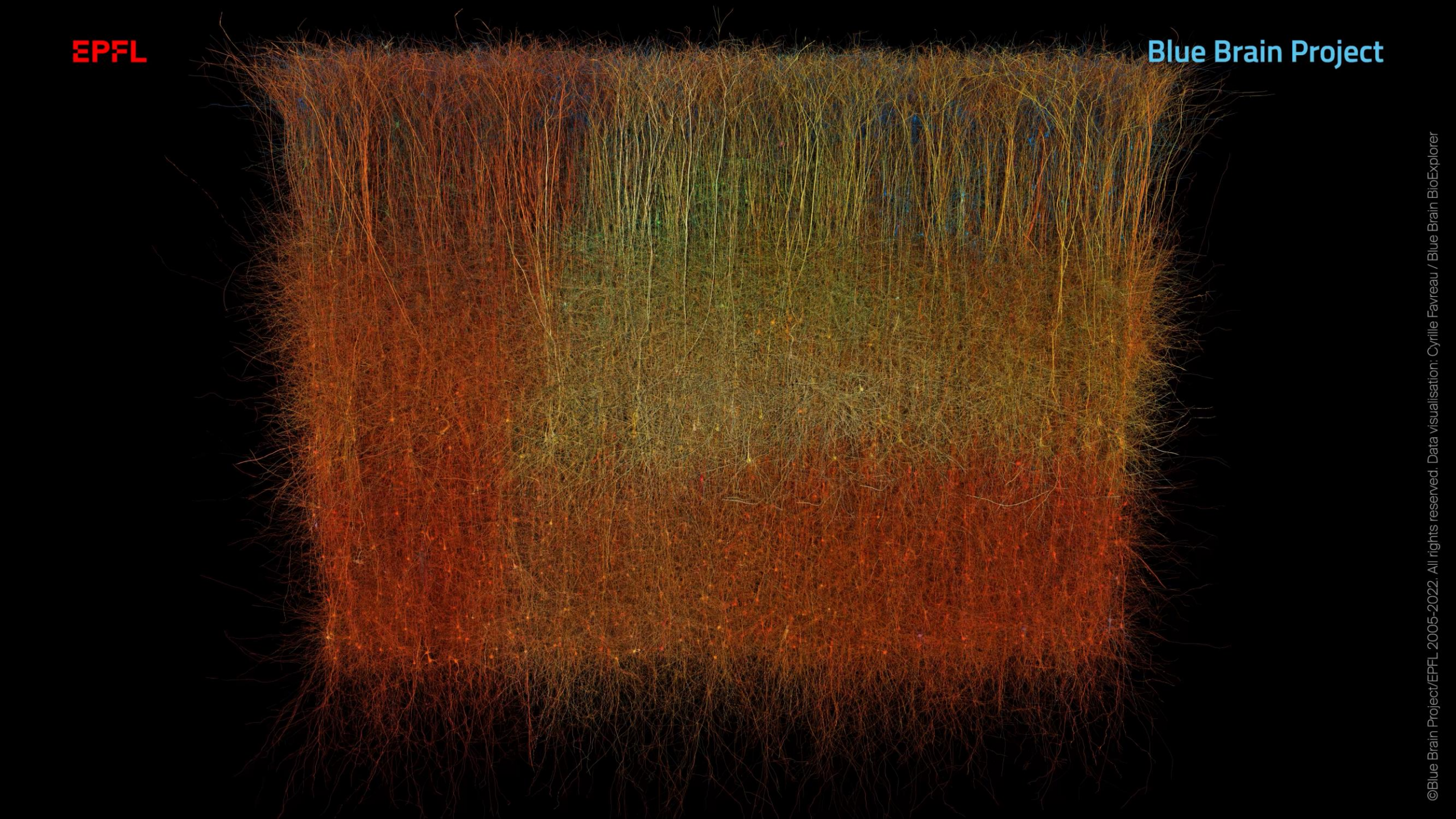
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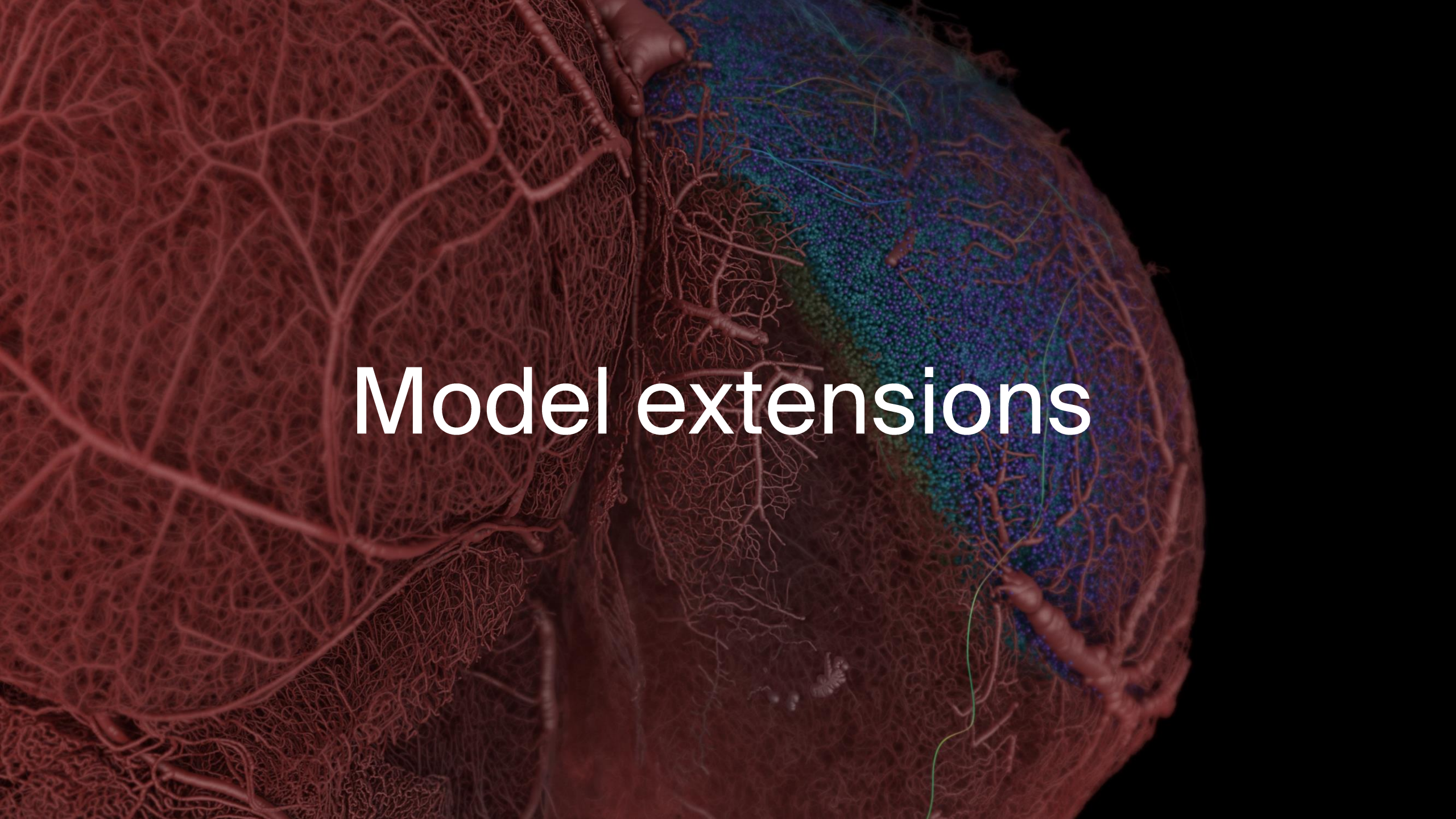
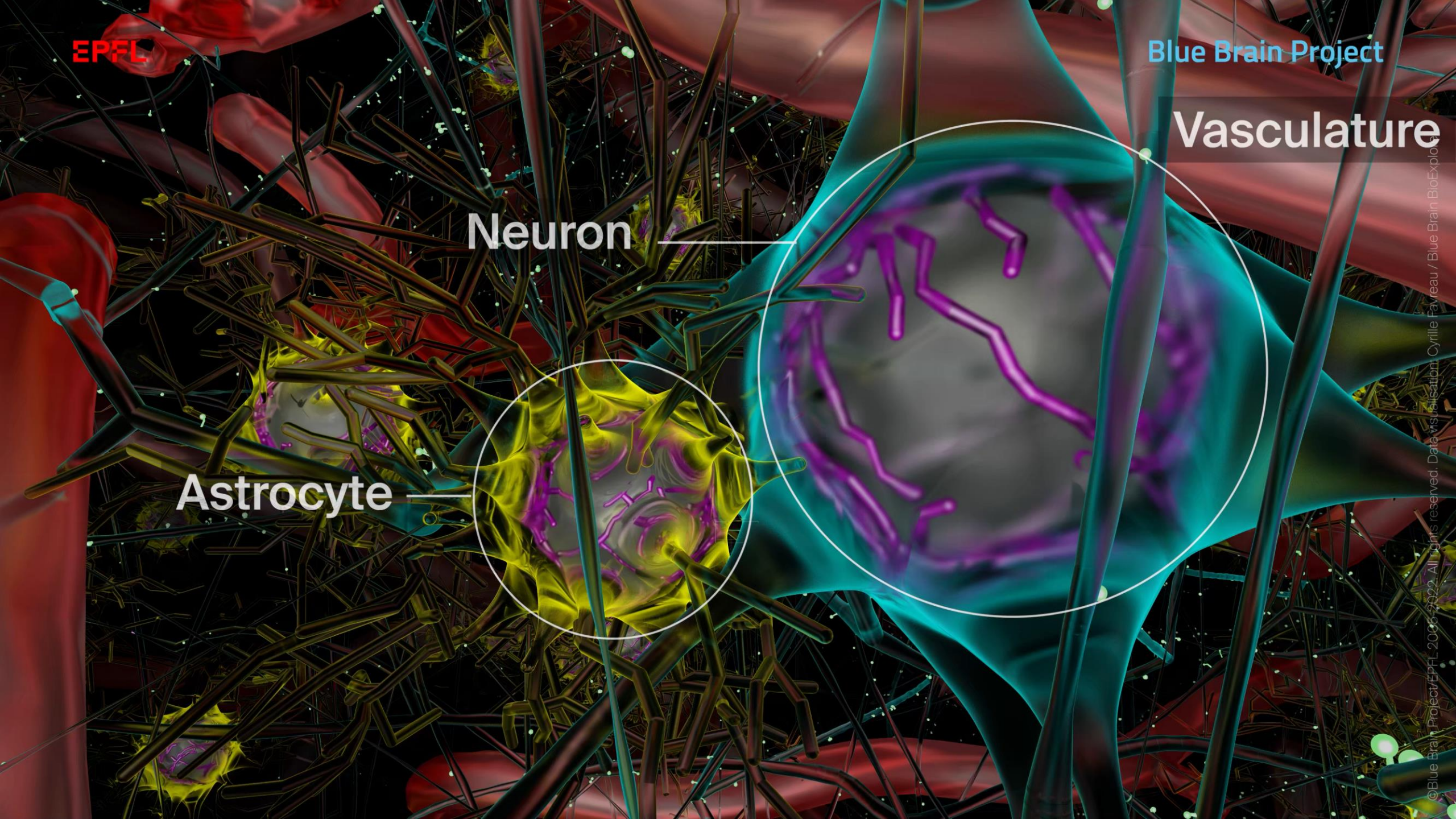


Model extensions



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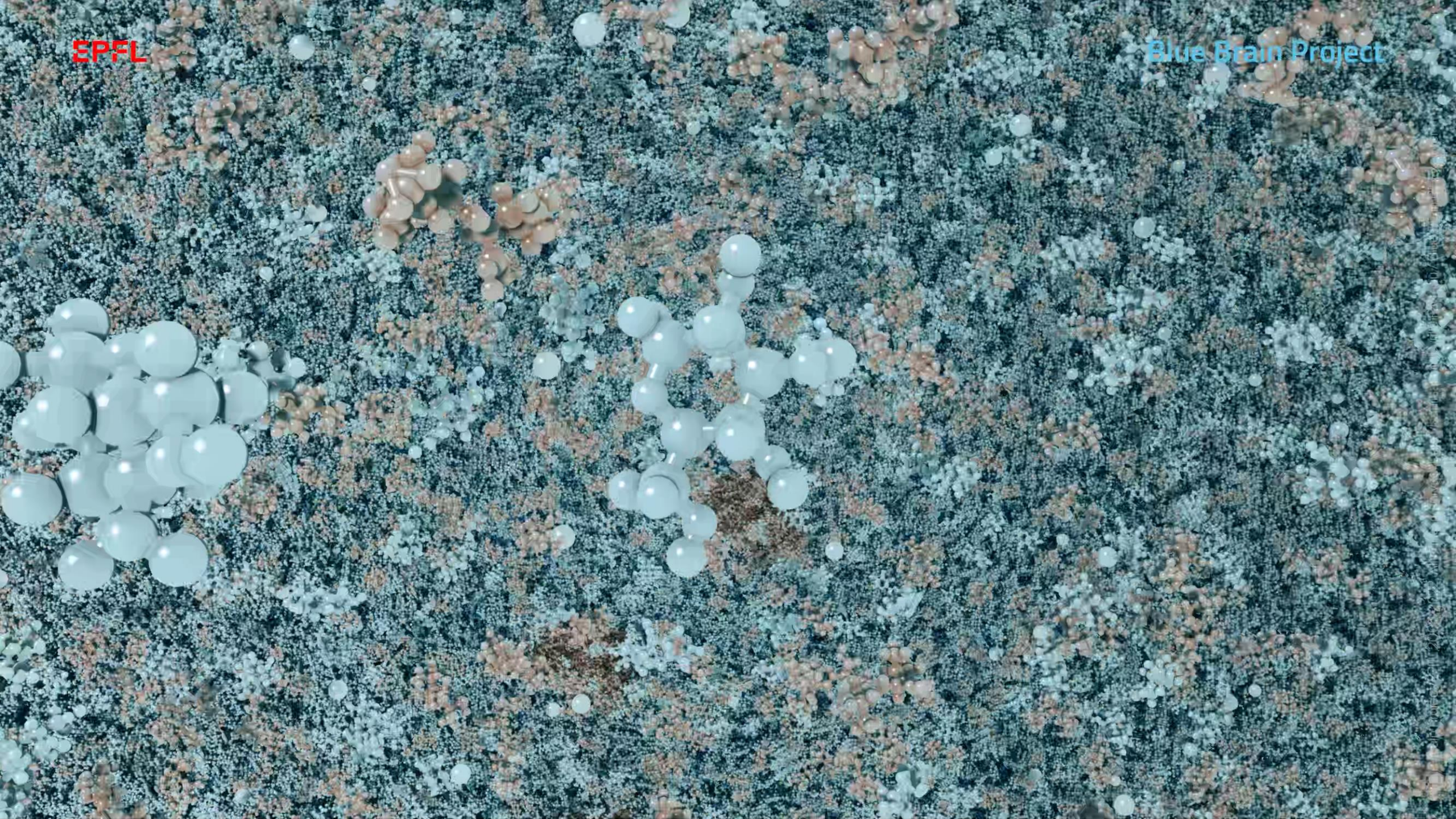
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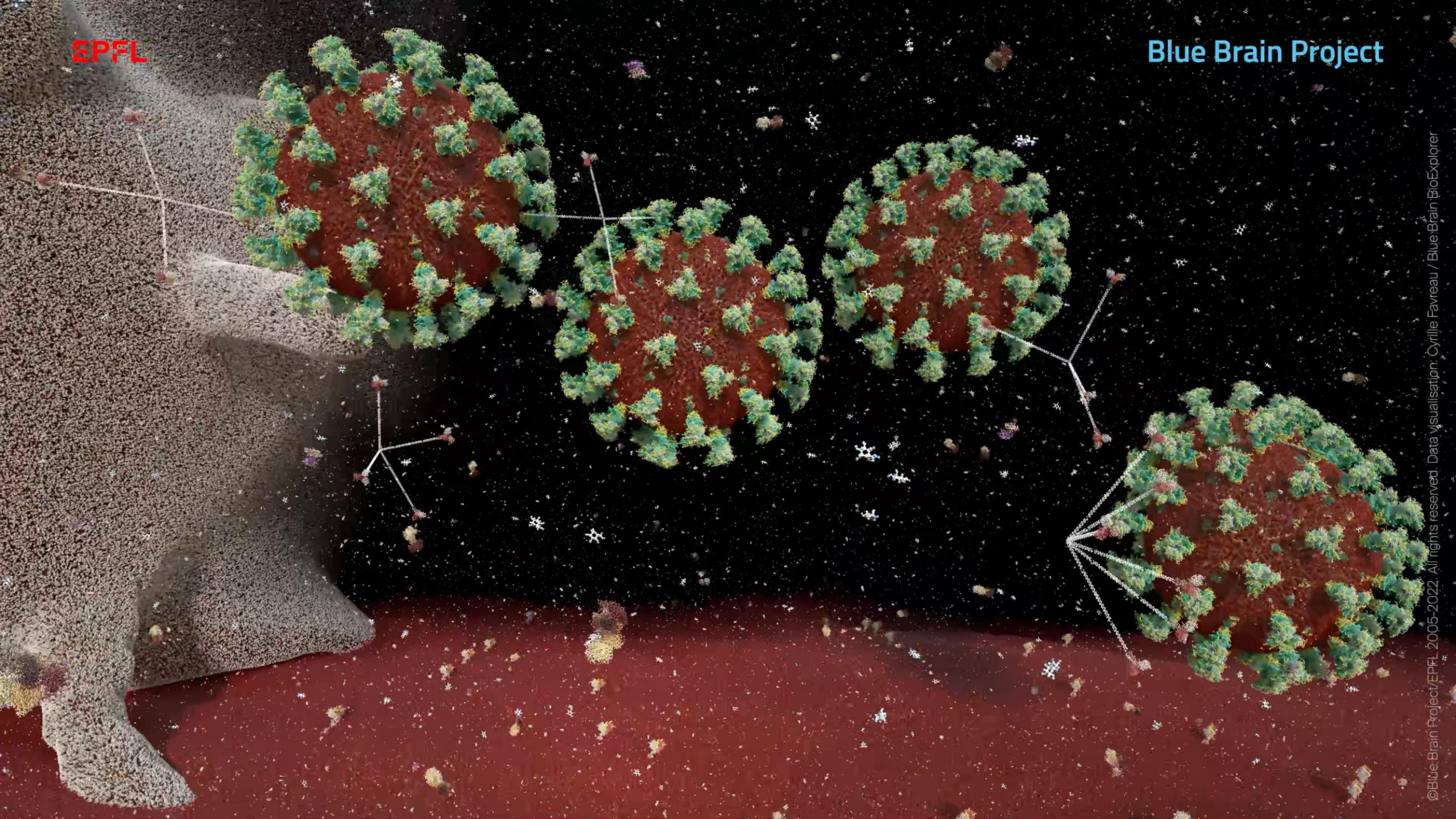
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Blue Brain BioExplorer

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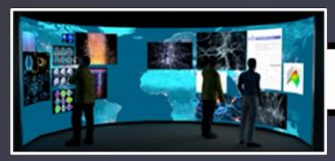
Blue Brain BioExplorer timeline

Blue Brain Project



OpenDeck

Generic UI

Python notebooks over WS

OptiX GPU engine

OSPRay CPU engine

Brayns

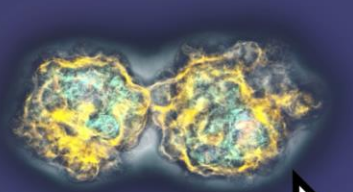
2015 ... 2019

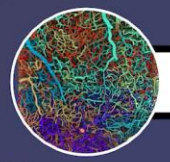
Phase 1: Engineering

Harvard Brain Interview

Brain atlas

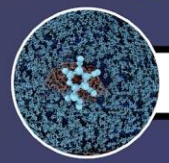
Neurons & Astrocytes



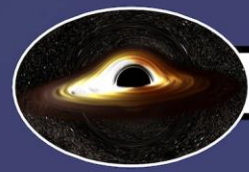


Vasculature

Sub-atomic particles

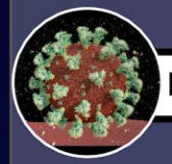


Metabolism

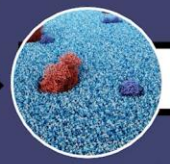


Cosmology

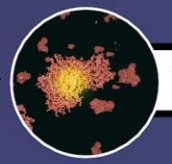
Neuromodulation



Molecular systems



Ion channels



Enzyme reactions

Scientific visualization and exploration platform

2020 2021 2022 2023

Phase 2: Scientific visualization and visual exploration

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Notifications Fork 9 Star 41

Code Issues 1 Pull requests Actions Projects Wiki Security Insights

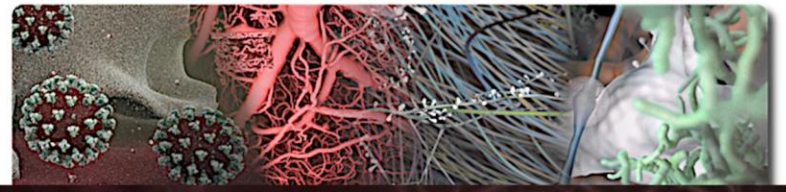
master 3 branches 12 tags Go to file Code

favreau Merge pull request #189 from favreau/master ... d5b917d last week 959 commits

.github/workflows	Documentation on how to create and use a Docker image for the Pos...	7 months ago
CMake	Added Xmp metadata to generated images	5 months ago
bioexplorer	Version 1.5.0 preparation	2 weeks ago
docs	Version 1.5.0 preparation	2 weeks ago
extras	Documentation and copyright update	last month
storage/database	Documentation and copyright update	last month
.clang-format	Full refactoring of protein loading	3 years ago
.gitignore	Minor UI fixes	2 years ago
ARCHITECTURE.md	Documentation improvements: Minor spelling mistakes	7 months ago
AUTHORS.txt	Set license to GPL	3 years ago
CMakeLists.txt	Version 1.5.0 preparation	2 weeks ago
CONTRIBUTING.md	Banner and README update	2 years ago
DOCKER.md	Minor documentation and notebook edits	6 months ago
Dockerfile	Documentation and copyright update	last month
LICENSE.md	Made Licence file compatible with Github	2 years ago
README.md	Contact update in the README	last week
docker-compose.yml	Fixed docker issues	2 years ago

README.md

Blue Brain BioExplorer



About

The Blue Brain BioExplorer (BBBE) is a tool for scientists to extract and analyze scientific data from visualization and interactive exploration

python science virus neuroimaging raytracing rendering-engine neuron brain molecular-biology dti virology astrocyte immune-system neurosimulation coronavirus covid19 sars-cov-2 glucose-levels vasculature viral-infection

Readme
GPL-3.0 license
41 stars
4 watching
9 forks

Releases 8

1.5.0 Latest
2 weeks ago

+ 7 releases

Packages

No packages published

Contributors 2

favreau Cyrille Favreau
jplanasc Judit

Languages

C++ 40.1% Jupyter Notebook 27.4% TypeScript 18.5% Python 12.0% CMake 1.3% Dockerfile 0.3% Other 0.4%

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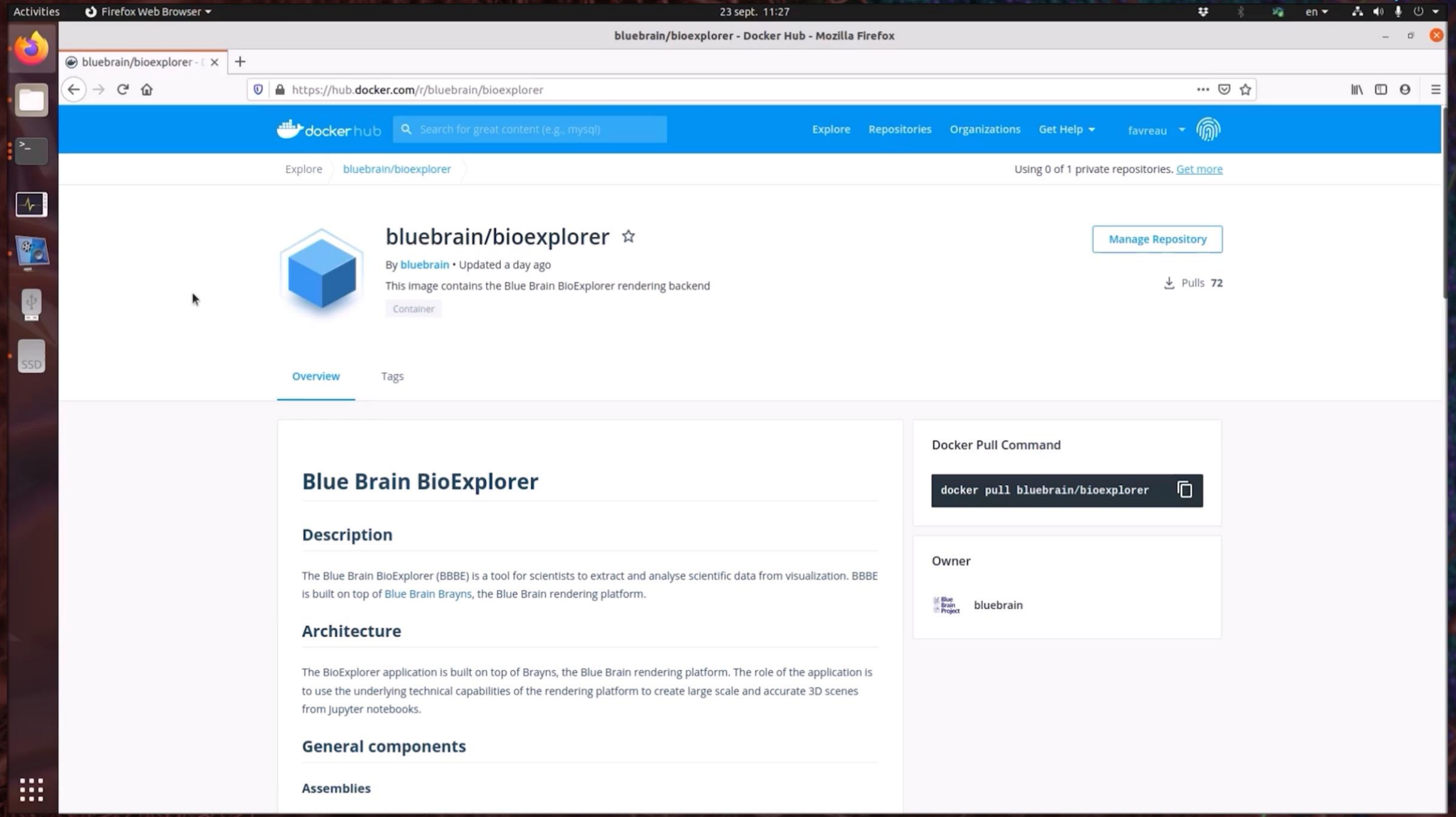

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Scientific use-cases

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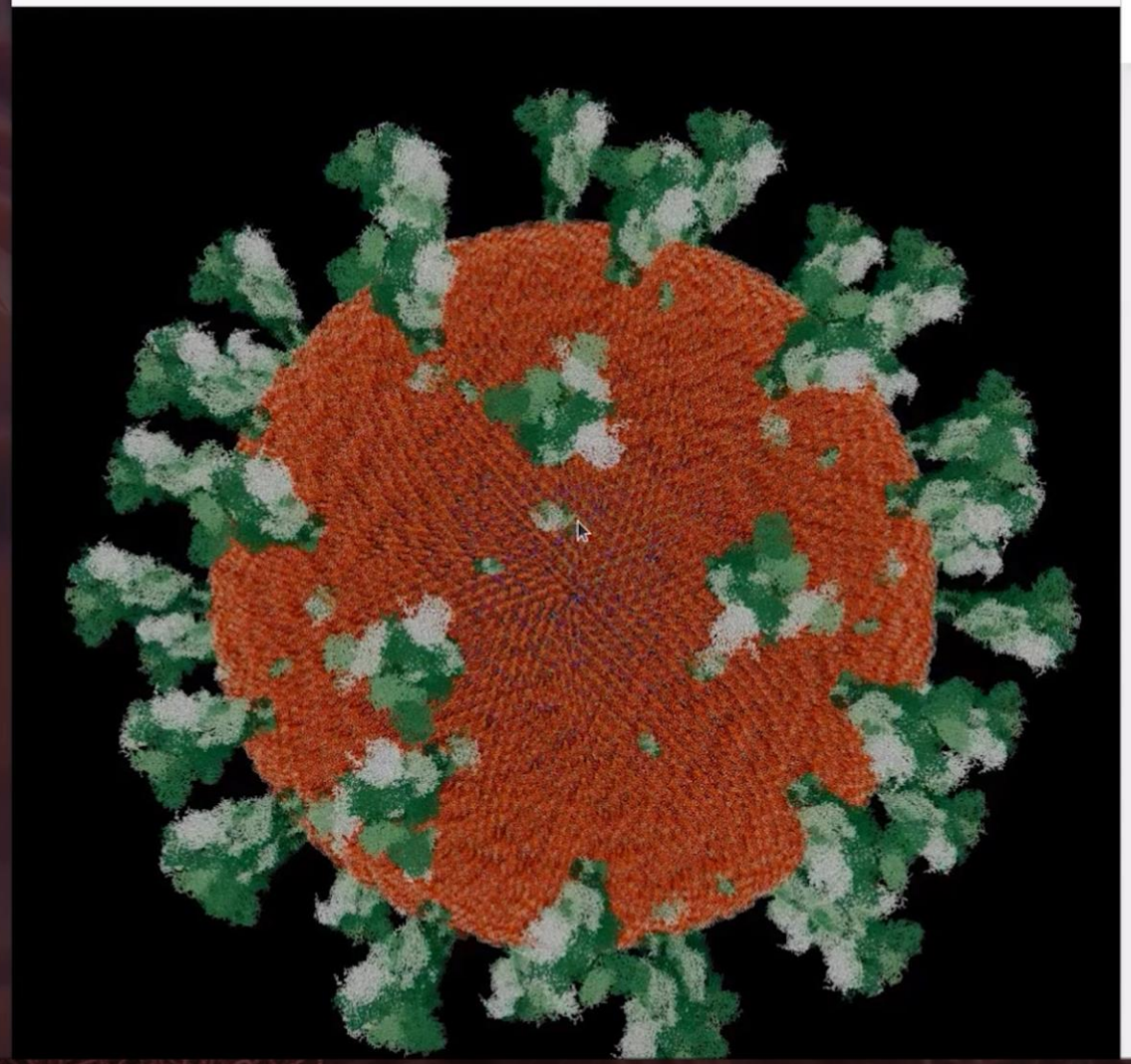
Blue Brain Project

Activities Firefox Web Browser 23 sept. 11:31 en

BioExplorer - Mozilla Firefox

bluebrain/bioexplorer - [BioExplorer

192.168.1.26:5002/?host=192.168.1.26:5000



BioExplorer_simplest_example - Jupyter Notebook - Mozilla Firefox

Home Page - Select or cr BioExplorer_simplest_ex

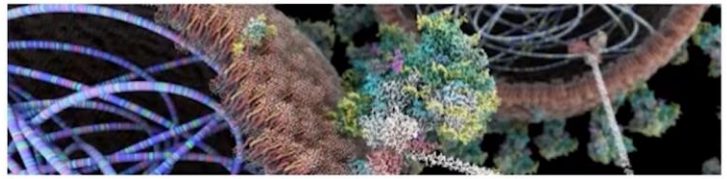
192.168.1.26:5001/notebooks/BioExplorer_simplest_examp

jupyter BioExplorer_simplest_example (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help Not Trusted Python 3

Run Code

Blue Brain BioExplorer



Simplest script to create a visualization of a Coronavirus

In [1]:
```
from bioexplorer import BioExplorer
be = BioExplorer('192.168.1.26:5000')
```

In [2]:
```
name='Coronavirus'
be.add_coronavirus(name=name, resource_folder='../tests/test_files/')
```

In [ ]:
```
status = be.set_protein_color_scheme(
    assembly_name=name, name=name + '_' + be.NAME_PROTEIN_S_CLOSED,
    color_scheme=be.COLOR_SCHEME_GLYCOSYLATION_SITE,
    palette_name='Paired', palette_size=2)
```

In [ ]:
```
status = be.set_protein_color_scheme(
    assembly_name=name, name=name + '_' + be.NAME_PROTEIN_S_CLOSED,
    color_scheme=be.COLOR_SCHEME_CHAINS,
    palette_name='Set3', palette_size=4)
```

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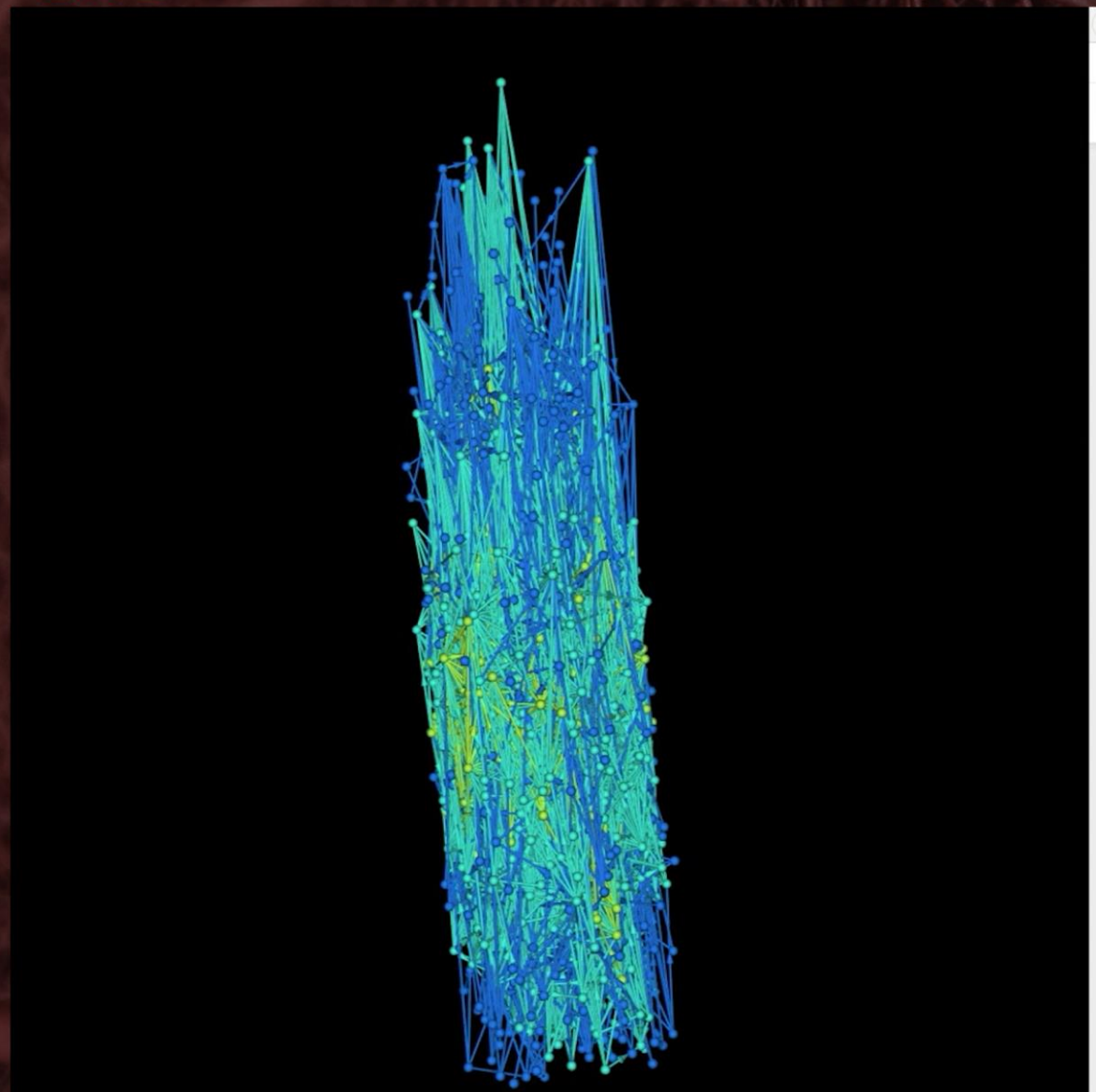

128.178.97.68:8888/notebooks/Topology Viewer.ipynb

jupyter Topology Viewer Last Checkpoint: 03/26/2018 (autosaved)

Logout

File Edit View Insert Cell Kernel Widgets Help

Trusted Python 3

Run Code

In [21]:

```
import viztools
topology_file_path = "/home/jkarlsso/Work/tw_data1/transmission_response_matrices.h5"
animation_file_path = "/home/jkarlsso/Work/tw_data1/transmission_response_matrices.h5.anim"
tv = viztools.TopologyViewer('128.178.97.68:5000')
tv.init_topology(topology_file_path, animation_file_path)
tv.draw_gui()
```

Neuron type filter

Layer	E-Type	M-Type
Any	Any	L6_BPC
I	bNAC	L6_MC
II	cNAC	L6_BTC
IIIV	cSTUT	L6_DBC
IV	cACintcIR	L6_BP
V	cIR	L6_NGC
VI	cADpyrbAC	L6_LBC
	bAC	L6_NBC
	dNAC	L6_SBC
	bIR	L6_ChC

Order filter

- Order 0
- Order 1
- Order 2
- Order 3
- Order 4
- Order 5
- Order 6
- Order 7
- Order 8

Order colors

Order 0	#555555
Order 1	#0080ff
Order 2	#16fedf
Order 3	#a8ff4c
Order 4	#f2f701
Order 5	#ffb500
Order 6	#ff2400
Order 7	#b80000
Order 8	#880000

View

Neuron radius 10.0

- Connections visible
- Directions visible

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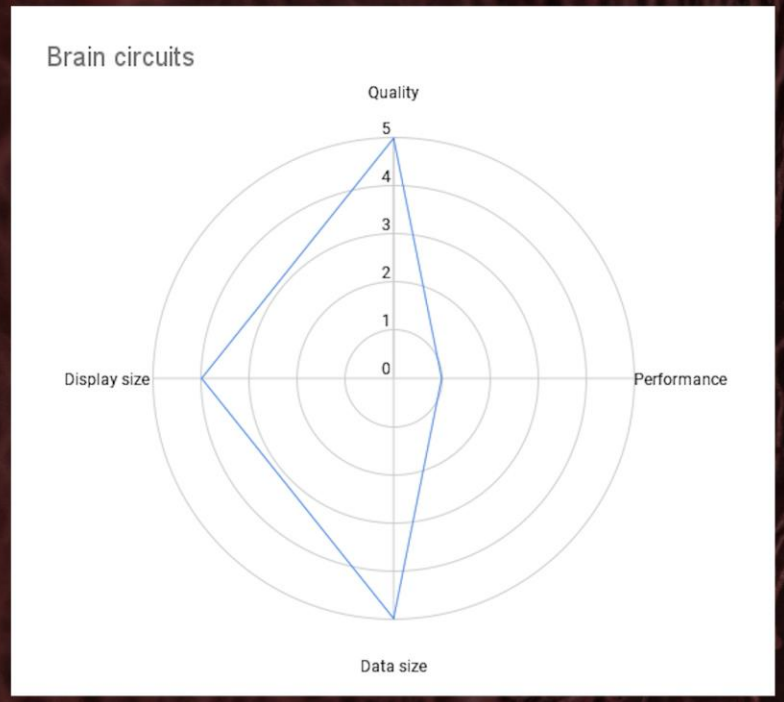

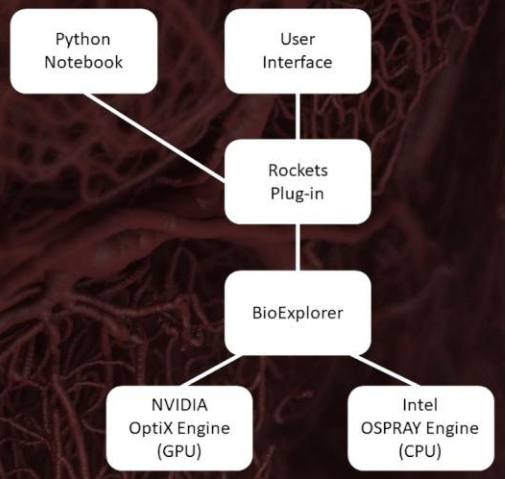

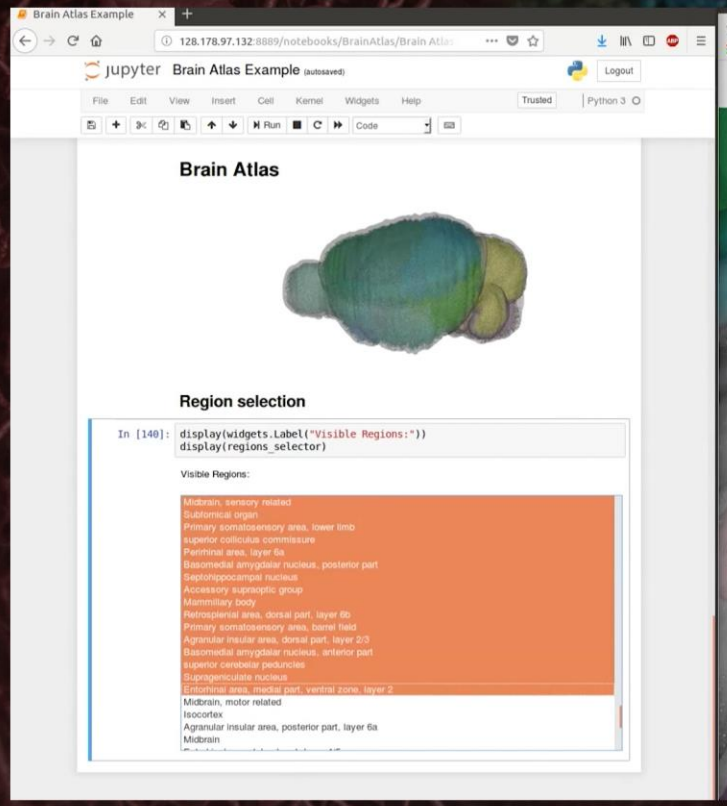

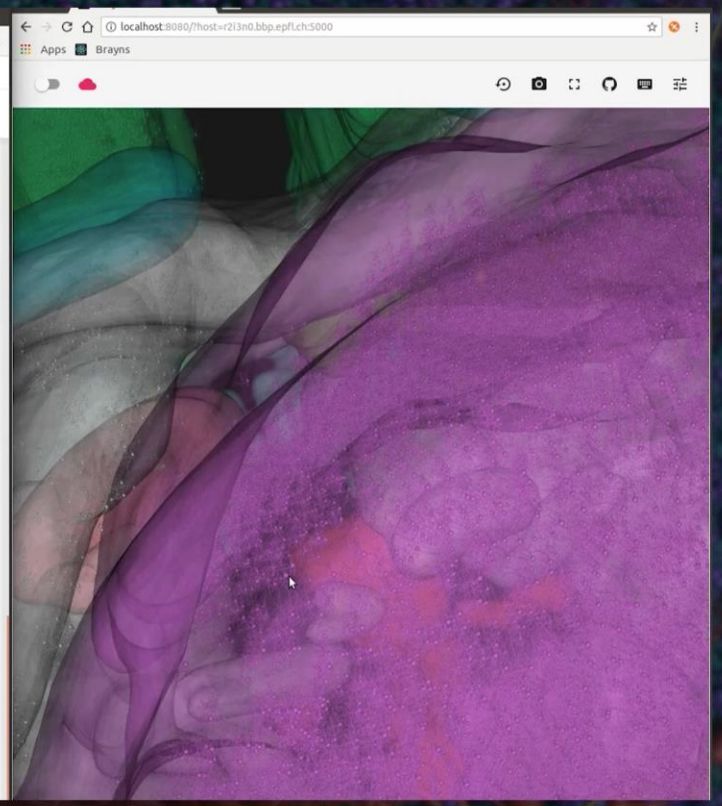

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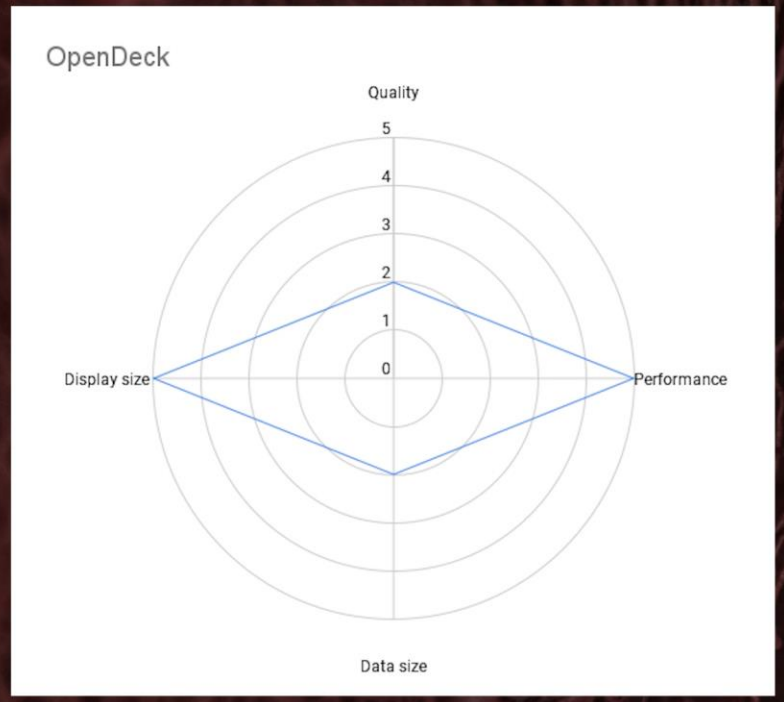

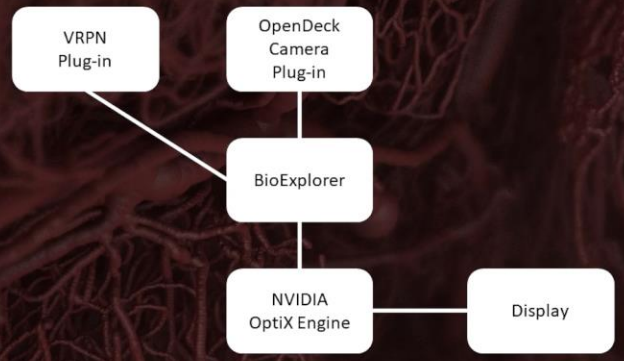

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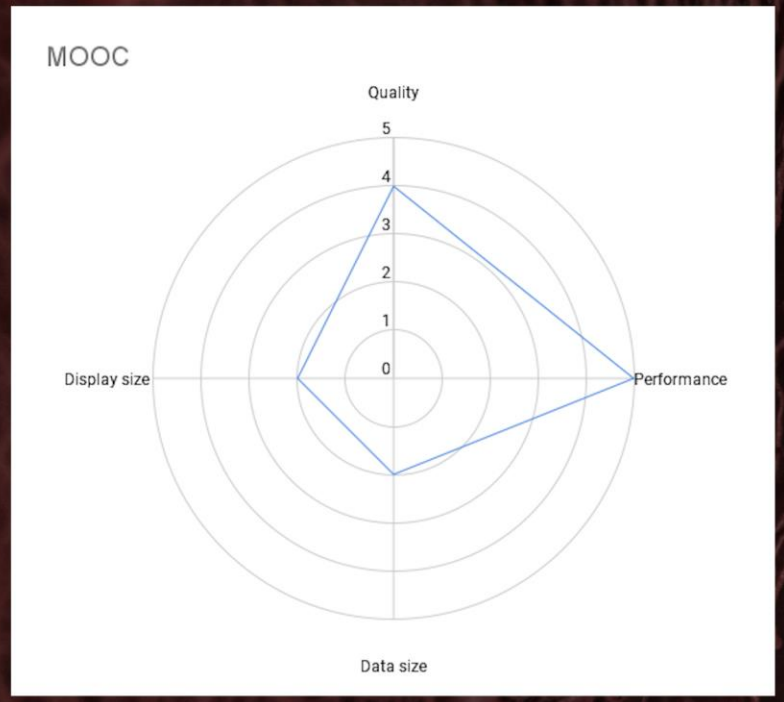

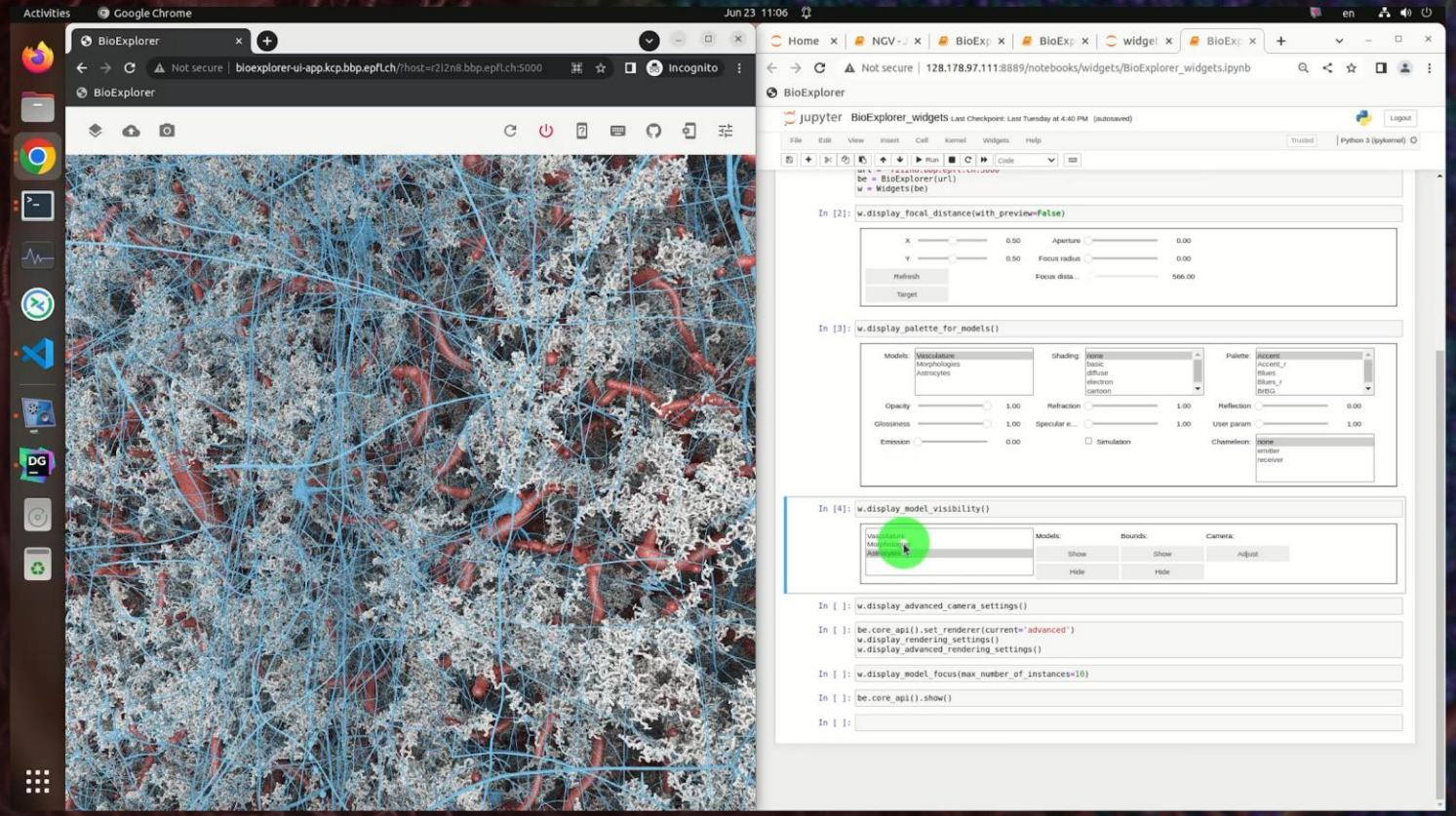

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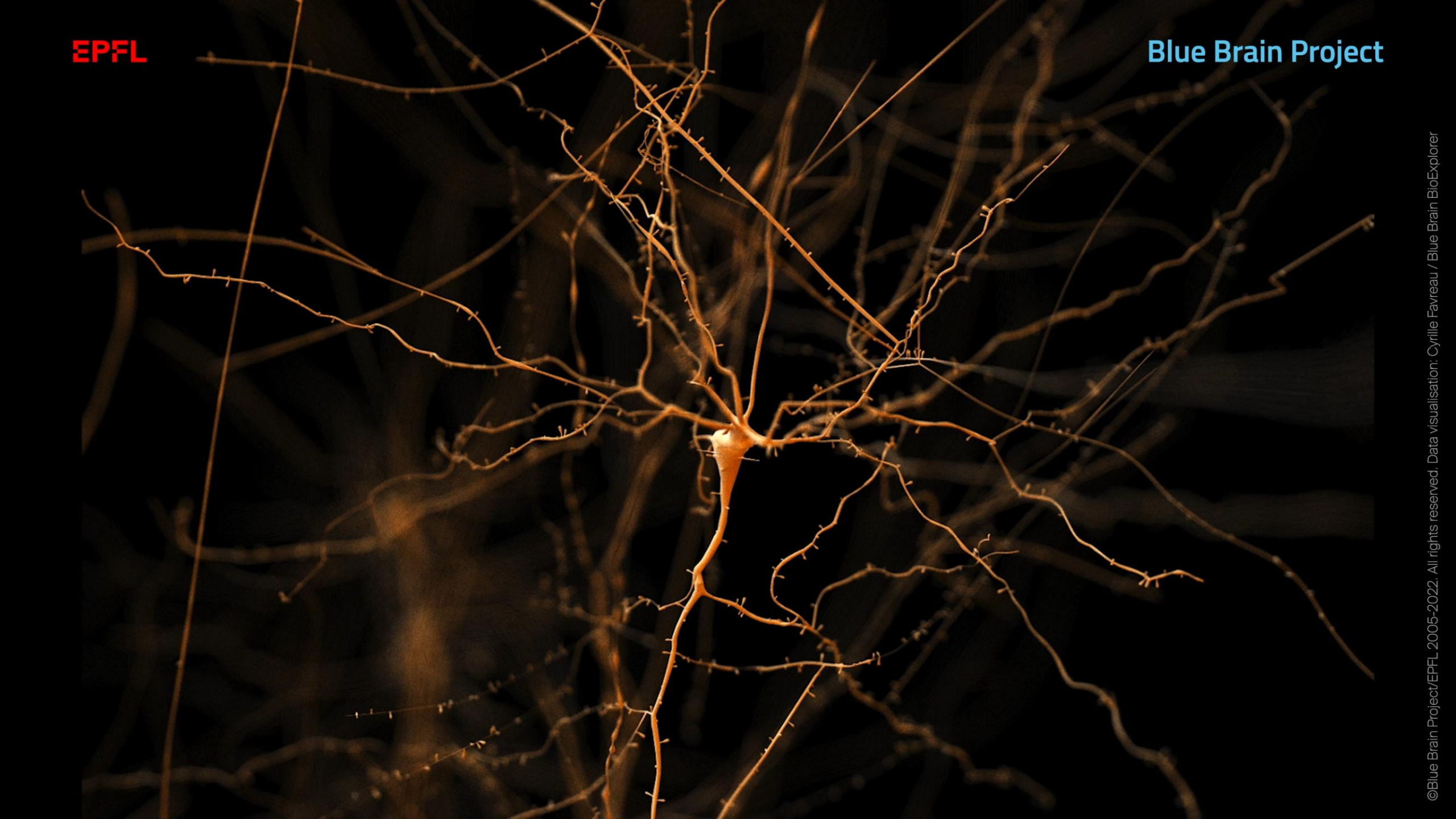

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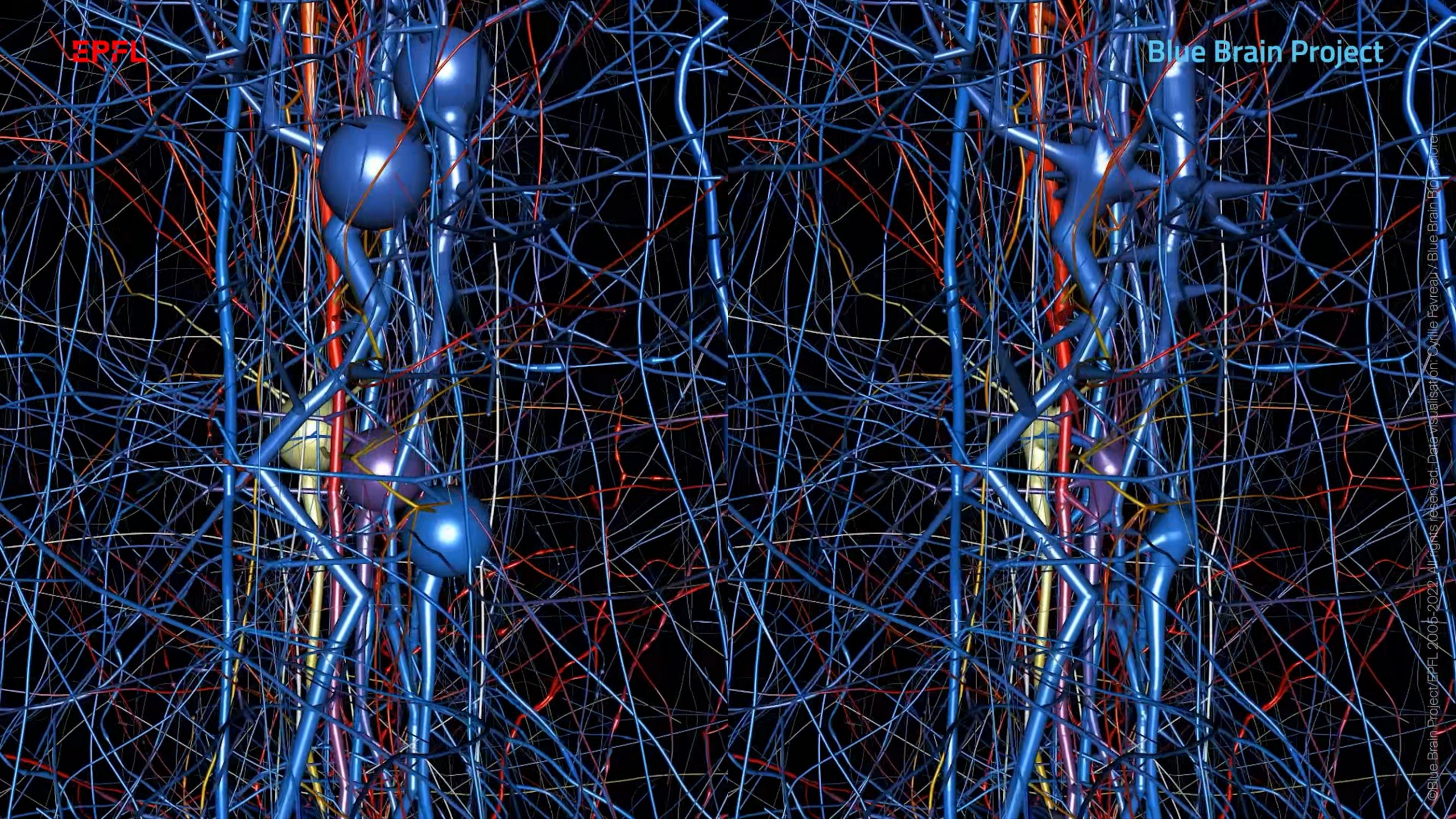

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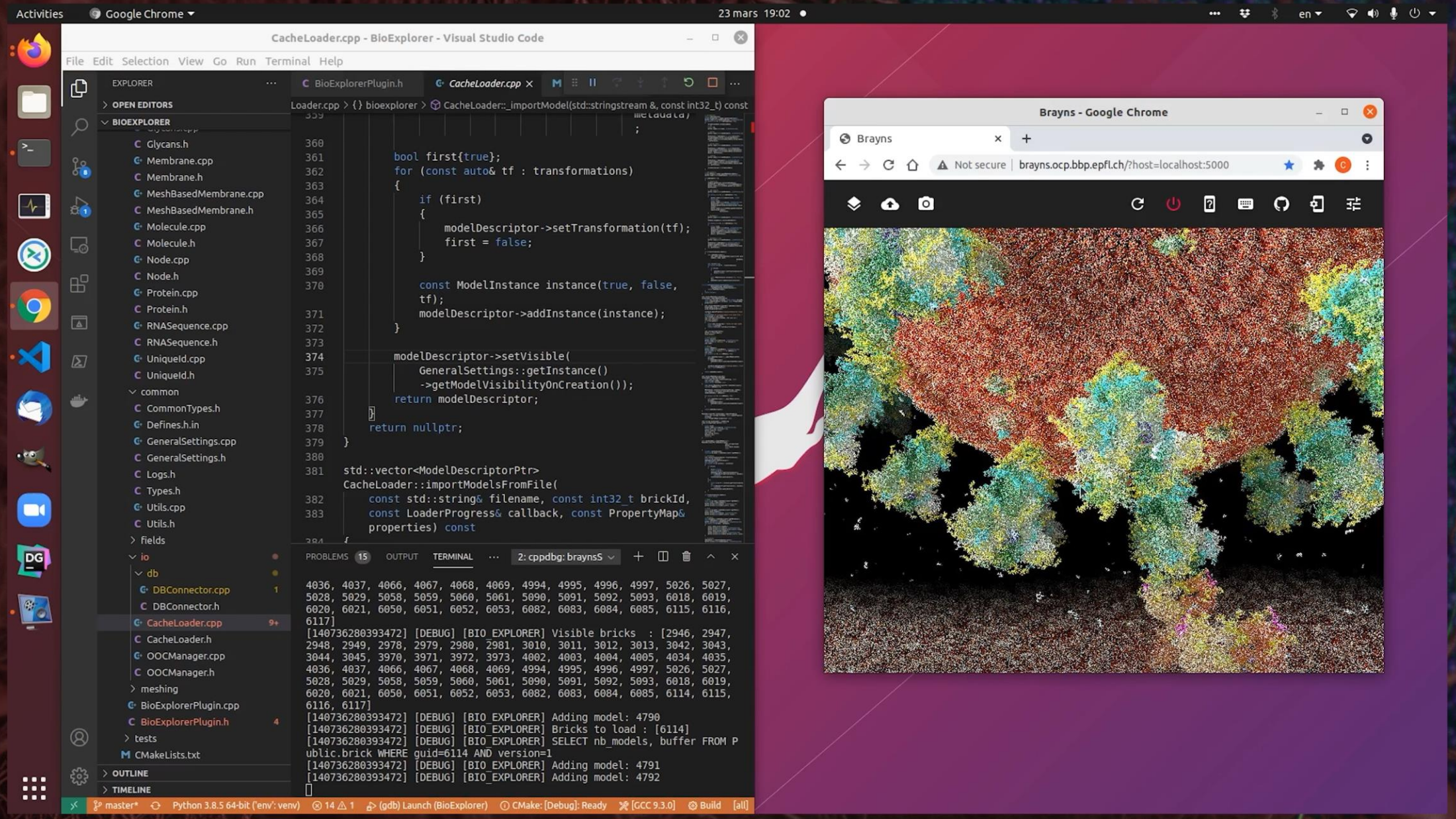

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Blue Brain BioExplorer for sub-atomic worlds

Particles Composition and Interactions Using the Nuon Model

René Brun

CERN, Geneva, Switzerland.

DOI: 10.4236/jmp.2023.145036 **PDF** **HTML** **XML** **126** Downloads **965** Views

Abstract

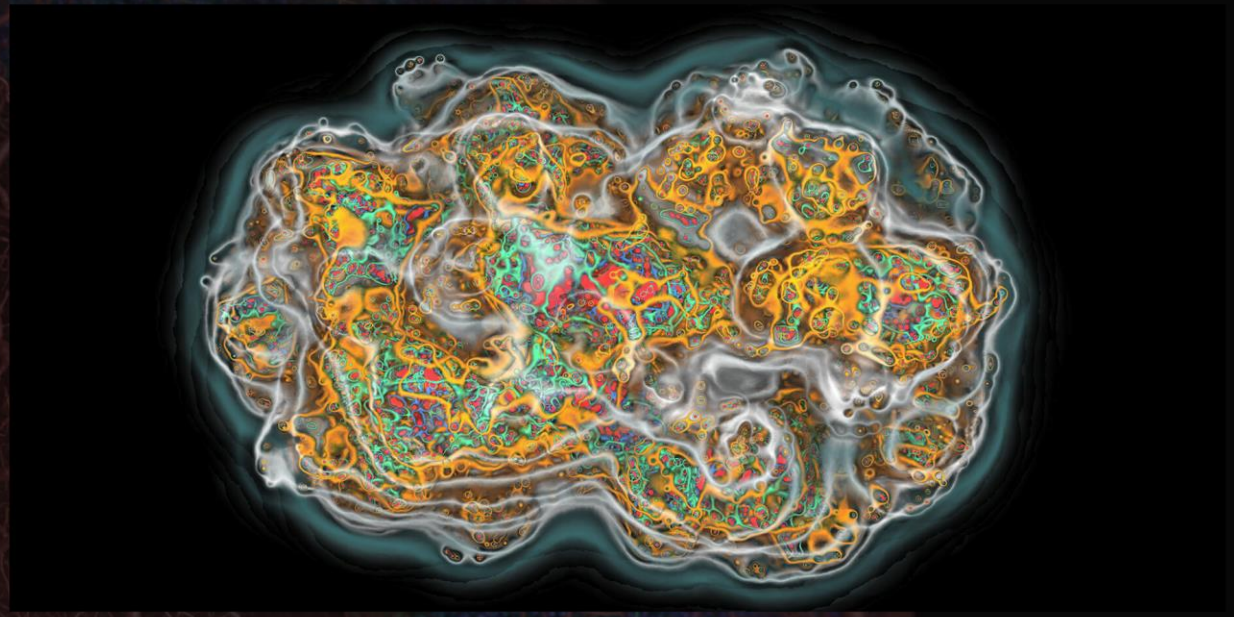
The Standard Model in Particle Physics has been able to make many predictions confirmed later with a flow of experimental results. With the discovery of the Higgs boson at the LHC, one is full of admiration for the people contributing to this model fifty years ago and its predictions that have been confirmed gradually. The original particle quark constituent model has evolved with the deep inelastic experiments to a quark and gluons system, then to a more general system with virtual quarks. This work is the result of observations while working at CERN in Geneva with many different experiments at the ISR, SPS, LEP, LHC colliders. A new model based on nuons is introduced, that allows accurate evaluations of the particle masses (mesons and baryons) and magnetic moment, computes very accurately the kinematics distributions for particles and jets observed in the p-p collisions at the LHC (elastic and inelastic) and at lower energy machines. This new model looks at a first glance in contradiction with the quark model because it can build the elementary particles with nuons only, *i.e.* electrons and neutrinos. However, all the existing physics involved in electron, positron and neutrino interactions may be used to explain interactions between composite particles such as protons or heavy ions.

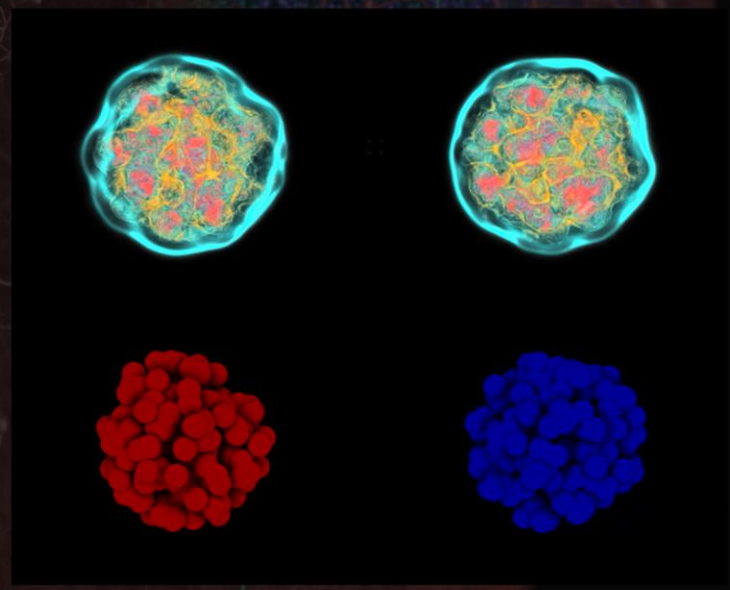
Keywords

Standard Model, Particle Masses, Particles Interactions, Elastic Scattering, Deep Inelastic, Jets, Charge Density

Share and Cite:

Brun, R. (2023) Particles Composition and Interactions Using the Nuon Model. *Journal of Modern Physics*, **14**, 623-665. doi: 10.4236/jmp.2023.145036.





Science outreach

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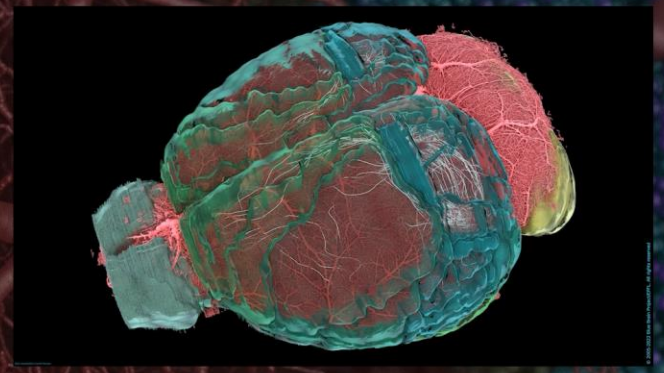
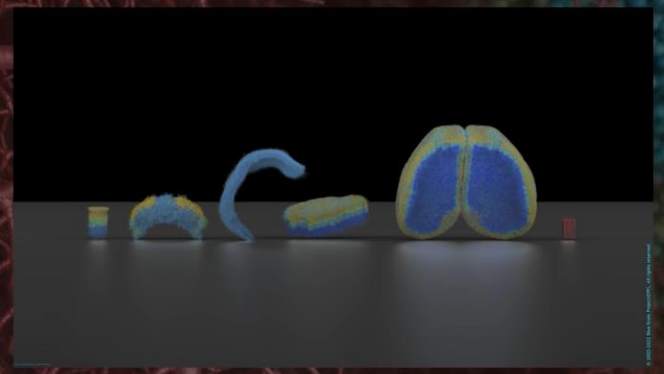
Blue Brain Project is featuring
in the BRAIN(S) exhibition at the
Barcelona Centre of Contemporary Culture and **Fundación Telefónica Madrid**

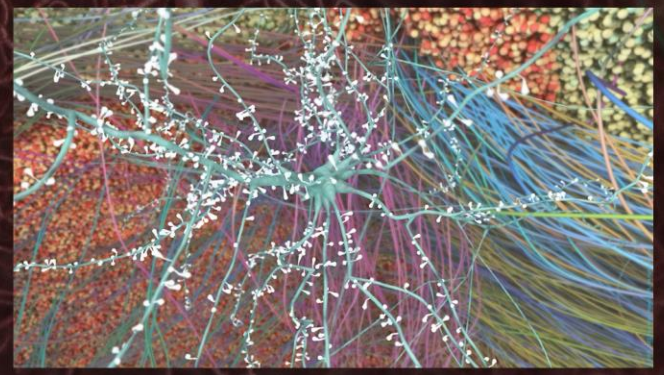
Barcelona
27 July - 11 December 2022

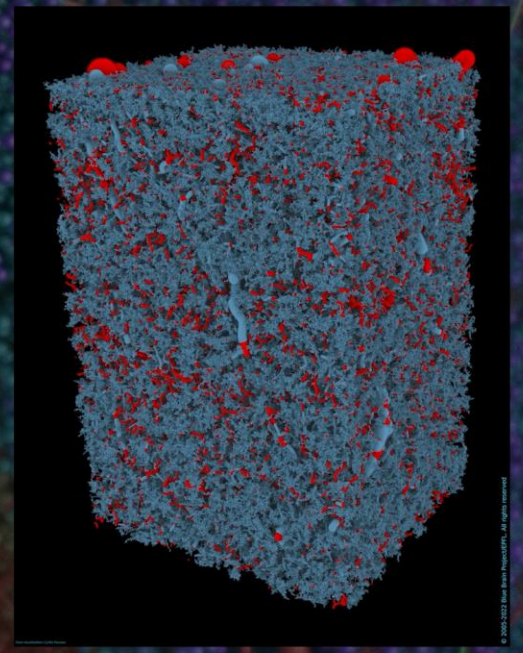
Madrid
22 December 2022 - 16 June 2023

cccb.org/en/exhibitions/file/brains/237851









Barcelona Centre of Contemporary Culture - 2022-2023

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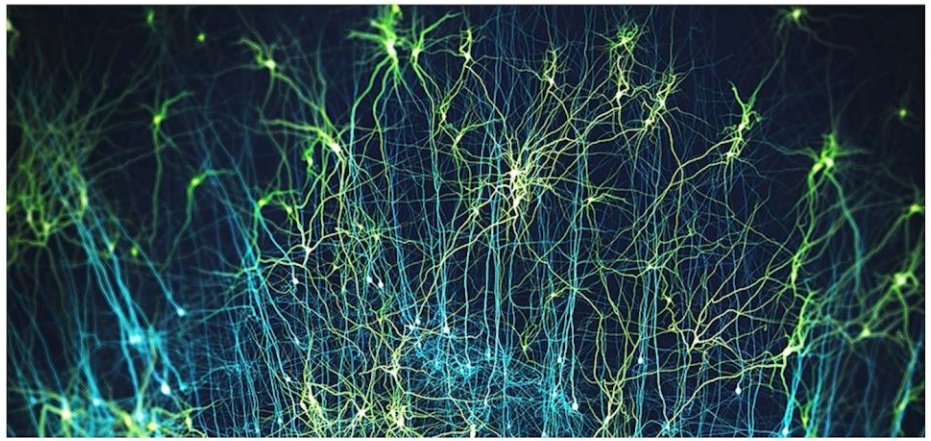
Hôpitaux Universitaires Genève



24 mai 2022 - 27 novembre 2022

Les HUG ont le plaisir d'accueillir l'exposition photographique Blue Brain Project de l'EPFL.

Le Blue Brain Project est une initiative suisse de recherche sur le cerveau fondée et pilotée par le Pr Henry Markram. Son but est de créer, pour la première fois au monde, des reconstructions numériques et des simulations biologiquement détaillées du cerveau de la souris. La visualisation scientifique est un élément clé de la recherche du Blue Brain Project. Les images exposées montrent quelques exemples de ces visualisations.

Hôpitaux Universitaires de Genève - 2022

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Greg Dunn *Brainbow Hippocampus in Color* (détail), 2014
© Greg Dunn and Brian Edwards

Jeremy Shaw *Phase Shifting Index* 2020 Installation vidéo avec son
Courtesy Jeremy Shaw et König Galerie, Berlin

Centre Pompidou

Franck Riester
Ministre de la Culture

Serge Lasvignes
Président du Centre Pompidou

Bernard Blistène
Directeur du Musée national d'art moderne / Centre de création industrielle

Frank Madlener
Directeur de l'Institut de recherche et coordination acoustique / musique

prient Monsieur Cyrille Favreau
de bien vouloir assister à l'inauguration des expositions

dans le cadre de **Mutations / Créations #4**

Neurones, les intelligences simulées
et
Jeremy Shaw
Phase Shifting Index

Mardi 25 février 2020
18h – 20h30
Galeries 3 et 4, niveau 1
Accès par l'entrée 2, face à la place Stravinsky
Fermeture à 21h, dernier accès à 20h30
Cliquez sur le lien pour accéder à la bande annonce de Neurones, les intelligences simulées
Cliquez sur le lien pour accéder à la bande annonce de Jeremy Shaw

Programmation de l'Ircam associée :

- **Forum Vertigo** : Intelligence artificielle et création artistique
mercredi 26 et jeudi 27 février 2020, Petite salle, niveau -1
- **Concert Ircam Live**
jeudi 5 mars 2020, 20h30, Grande salle, niveau -1

Invitation valable uniquement ce jour, pour deux personnes, sur présentation à l'entrée

ircam
Centre Pompidou

L'exposition Neurones, les intelligences simulées bénéficie du soutien de
Talan · MARSH

L'exposition Jeremy Shaw bénéficie du soutien de
KÖNIG GALERIE · Brillux

En partenariat avec
ARTE, 20 minutes
et les Inrockuptibles

Expositions présentées
du 26 février au 20 avril 2020

Mutations / Créations #4
bénéficie du soutien de
ENEDIS
L'ELECTRICITÉ EN RÉSEAU
Grand mécène

Le Forum Vertigo
bénéficie du soutien de
S·T·ARTS · scai

Centre Pompidou - Paris - February 2020

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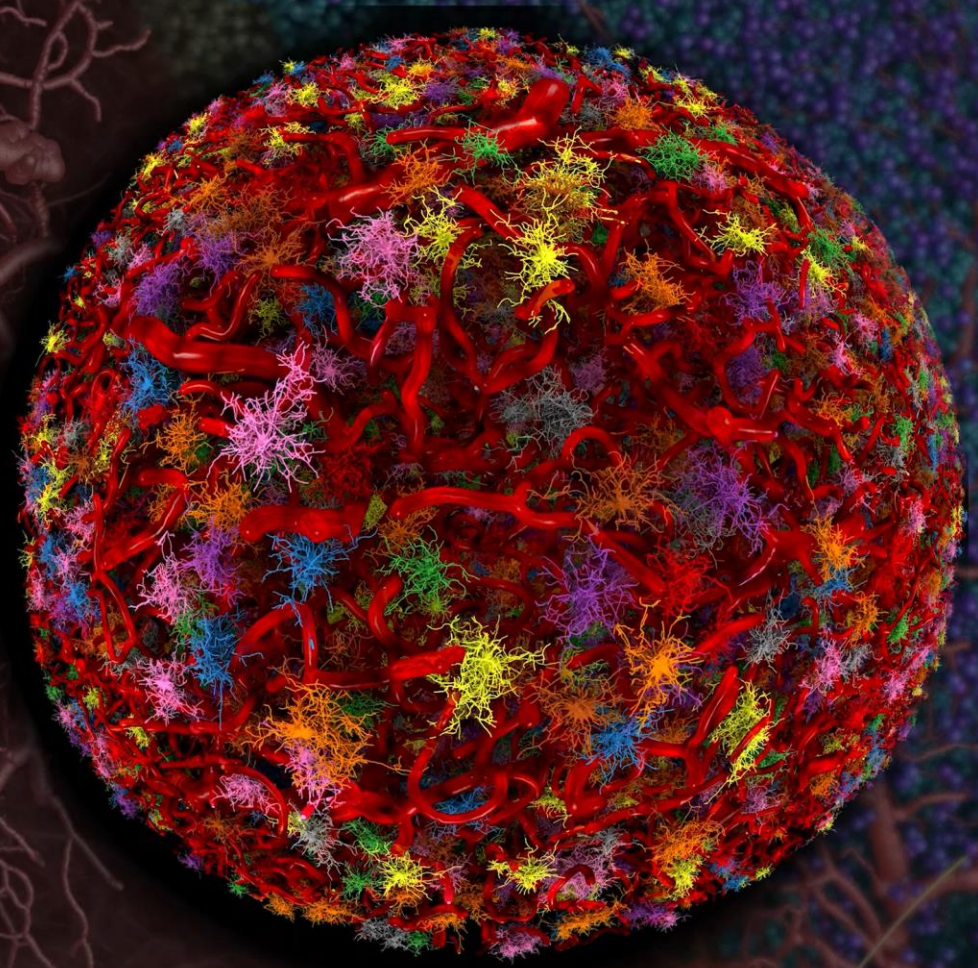
EPFL

eCAL / eM+

Blue Brain Project

Prof Sarah Kenderdine



EPFL 50th anniversary - December 2019

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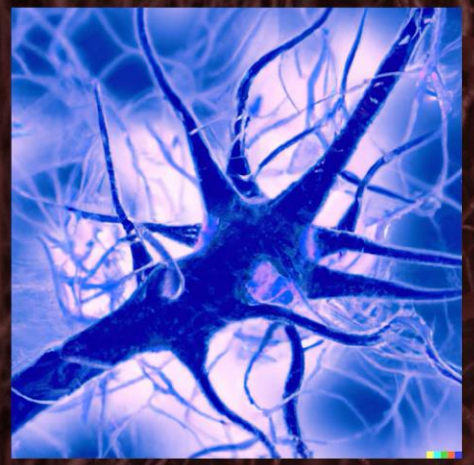

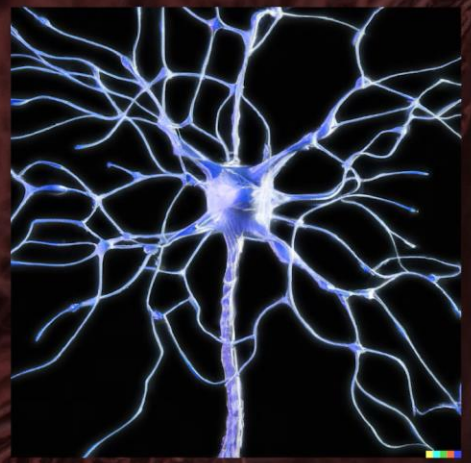

Generative AI vs High-fidelity visualization

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